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MOTORSHIP

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Devoted to Commercial and Naval Motor Vessels

Vol. 2 OCTOBER, 1917 No. 10

SEATTLE NEW YORK

MOTOR SCHOONER "GERALDINE WOLVIN" PASSING OUT TO SEA

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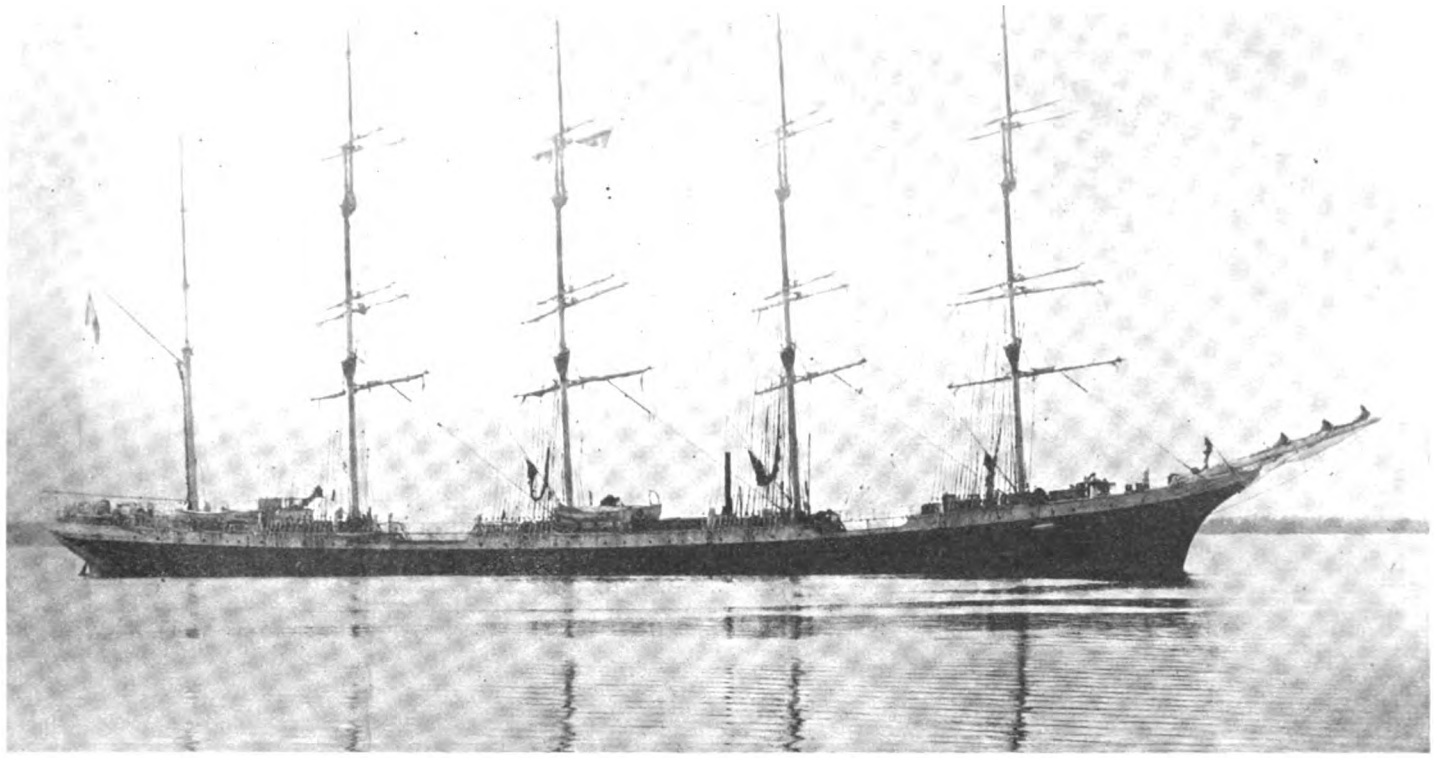
Vol. 2 SEATTLE, U. S. A., OCTOBER, 1917 No. 10

The "France" Visits New York City

By T. Orchard Lisle, A. M. I. Mar. E.



MOTOR AUXILIARY "FRANCE," HIGHEST POWERED MOTOR AUXILIARY AFLOAT, EQUIPPED WITH TWIN 900 B. H. P. SCHNEIDER DIESEL ENGINES

Chief Engineer Calves Discusses Diesel Engines With the Author

FOR the first time during the four and three-quarter years that she has been engaged in service, the five-masted auxiliary barque "France" visited New York City during the second week of August, where she attracted considerable attention, being the highest powered motor auxiliary afloat. Complete technical details and illustrations of the Diesel machinery of the "France" were given in Motorship for May. It will be remembered that she is of 10,500 tons displacement, and can carry 7,500 tons of cargo in her hold, in addition to fuel-oil for 20,000 miles. She has 75,000 sq. feet of canvas, and for auxiliary power is equipped with two Schneider Diesel, two-cycle type reversible motors, each of 1,200 i. h. p., or 900 brake h. p. at 180 r. p. m. normal speed. She is 430 ft. long by 56 ft. breadth and 24 ft. loaded draught.

She was built for Prenthout, Leblond & Leroux of Rouen, France, in 1912, and was engaged in the Rouen-New Caledonia (Southern Pacific Ocean) nickel ore trade, making three trips around Cape Horn and two through the Panama Canal; but now is operated by the Companie Francais des Marine et Commerce, of Paris, the New York representatives of whom are the States Marine & Commercial Co., a newly-formed and enterprising organization, also operating several steamships. Since this company have had her in hand she has been trading between such ports as Glasgow, Montevideo, Rosario, Buenos Aires and Santos, and has seven times been through the war zone. Her crew consists of 55 men. She brought to New York a cargo of bones, horns and linseed oil.

Coming up New York Harbor she created not a little furore, seeing that she needed no tugs, her two motors being quite sufficient. Twice in the zone she was approached by submarines, forming as she does a splendid target with her towering masts and enormous sail area and myriads of wire and rope rigging.

The first occasion was in the early part of January of this year; she was progressing northward under sail along the Irish coast. The watch in the crow's nest about 10 o'clock in the morning reported that he had seen the wake of a torpedo about 10 feet astern of the bark. Instantly the U-boat appeared about a thousand yards away on the port side.

The "France" carries two guns aft. Both were trained on the submarine and the gunners succeeded in firing before the Germans could bring their guns into play, but the two shots fell short of the mark. Then a running fight began and lasted for about an hour. The crew of the "France" believed that the Germans ran out of ammunition, for without any apparent reason they suddenly veered in their course and permitted them to proceed.

The damage to the ship was not extensive. There were a few perforations in the sails, but they were hauled down as soon as the fight started. Some parts of the rigging were shot away.

The second time the "France" sighted a submarine there was no battle, although the gunners and crew were prepared. A submarine was seen about a mile away. She was approaching the bark when she found it necessary to submerge, as a British destroyer was speeding to the scene.

Each time the "France's" sails were hauled down as quickly as possible and the Diesel engines started up; but, as it takes six hours to set her canvas, it will be understood that changes from one power to the other are not made more often than possible, consequently the motors get very severe wear. Once they ran for a calm lasting for 22 days, and on another occasion for 16 days without a stop. She has done 17 knots for one day's average under sail; but, loaded, her speed under power alone is from 7 to 8 knots, or 10½ knots light.

A representative of Motorship had the pleasure of making an inspection while she was in New York, and was technically entertained in the engine-room for several hours by Chief Engineer, Mathurin Calves, who previously was a steam engineer, but now is a very competent Diesel engineer. Mr. Calves is exceedingly keen on his engines. He is a young man, 28 years old. Unfortunately, Diesel engineers now are very difficult to obtain in France, owing to the French navy having greatly increased its previously large submarine fleet, so that nearly all the good oil engineers are required for that service, some of the submarines running over 4,000 h. p. and nearly 2,000 tons displacement. Consequently the present engine-room staff of the "France" is reduced in number and some of the assistants are not very competent engineers. Yet, despite such drawbacks the two Diesel engines are operating in a perfectly reliable manner. When she leaves New York she will go to Australia with a cargo of case oil from the Standard Oil company.

We do not propose to re-describe the engines here, but through the courtesy of Chief Engineer Calves, we are enabled to give some interesting unpublished data regarding the four and three-quarter years operation. However, we will state that each engine has four cylinders (not six as stated in our May issue) 17.6″ bore by 22″ stroke and were designed to develop their power at 230 r. p. m., but, in the ship actually give their output

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at 180 r. p. m. We also are enabled to give a few details not previously described.

One thing that is remarkable is the size of the engines and the little amount of room they occupy for their power. Both are so small that it is difficult to realize their power. The entire machinery occupies a space of about 30 feet long at the stern of the ship, the engines themselves only being 22 feet long, including clutches, by 10 ft. high above the floor. Each working cylinder has an output of 300 i. h. p. so that the efficiency is excellent for a two-cycle engine.

The oil used generally has been a Mazaut crude oil of 930 gravity; but its engineer does not mind which sort of crude oil he picks up. It all burns without trouble. On this voyage he used African Peanut oil, which can plentifully be obtained in France. The fuel consumption with both motors running at full power is 6 tons (42 barrels per 24 hours), or at the rate of 180 grams per i. h. p., while the lubricating oil averages 10 grams for 24 hours.

Generally speaking her engines have proved themselves to be most successful; but it must be borne in mind that they were the first of their type built by Schneider & Company of Cruesot, France. There are six valves in each cylinder head, four of which are scavenging valves, one a fuel-injection valve, and the other an air-starting valve, (the latter is horizontal), yet not a single cylinder head has cracked from the time of her first voyage in December, 1912, to the present time. Four pistons cracked, however, through the oil-cooling supply temporarily failing. This can be prevented in future, as the cooling-oil outlet is inspected every 30 minutes by the engineer on watch, there being an open flow from each piston, arranged on the front of the engine. Telescopic pipes are used for oil-cooling of the pistons, and carbon from the cylinders has occasionally caused these to get hot and break. On the whole the oil-cooling has proved fairly efficient, but Chief Engineer Calves would prefer the water-cooling.

One advantage of oil-cooling, however, is that if the stuffing-boxes do leak a little, no harm is done, whereas salt water in the lubricating oil would mean stopping the engine to clear it out. Where cross-heads and guides are fitted this can be taken care of; but, in the case of the engine of the "France" no collecting trays can be fitted beneath the cylinders to collect carbon, oil, or water, making oil-cooling of pistons more advisable than otherwise would be the case.

When the piston oil-supply does give out, an explosive vapor naturally forms inside the piston from the drain of oil left, but in the case of the "France's" engines, the heat cracked the pistons before any explosion occurred and the vapor passed out through the crack without doing further harm.

Speaking of cross-heads and guides Chief Engineer Calves stated that the engine ran well without them, but their accessibility would greatly be improved had they formed part of their original design. There has only been a slight oval wearing of the cylinder walls, the amount for four and three-quarter years being but 2/10 mm. maximum in the middle of the cylinders. The other sides, if we may use the expression for a circular object, have shown no wear at all. Two cylinders heads were off at the time of our visit and the walls and pistons were as near perfect in condition as possible, speaking well for the quality of the metal and workmanship.

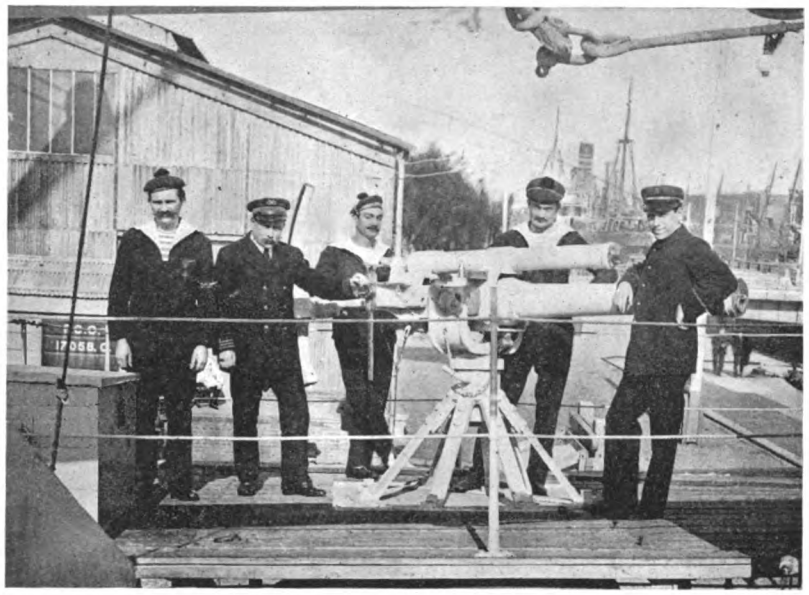
The wear of the main bearings and of the connecting-rod big end bearings has averaged but 2/10 mm. per 100 days operation, and the original white metal is still in position. No crank-shaft crack or fracture, ever has occurred, and the original (a beautiful one-piece forging) spare crank-shaft still hangs in position on the wall of the engineroom. Incidentally the wear of the bearings must be less than that ever previously known with a two-cycle type marine Diesel engine.

Burmeister and Wain of Glasgow appear to be partly responsible for the most serious mishap that has occurred to either engine of the "France." Their engineers thought that they could improve upon the cam arrangements of the fuel-injection valves of the "France's" engines and so fitted cam-pieces of their own design. Exactly what was the cause we were unable to ascertain, but, shortly after they were at sea, a smash-up occurred with its new cam-pieces, causing all the valve rockers of that engine and the small lay-rockers to get badly bent. The entire valve operating mechanism had to be taken down at sea and straightened out and the original cams replaced. This took the ship's engineers two months, during which time the ship was driven by the port motor. Bad metal was a part cause. (The relationship between the Burmeister & Wain Oil Engine Co., and Harland & Wolff was clearly revealed in connection with this, as the bill for this work was receipted by the Diesel Engine Department of Harland & Wolff, although on a Burmeister and Wain invoice).

Maneuvering of each engine is by a single hand-wheel at the forward end. Full ahead to full astern only takes 3 to 5 seconds. As the wheel is turned, air is admitted to cylinders 1 and 2, then fuel to 3 and 4, as well as air to 1 and 2. When the fuel is admitted to 3 and 4, the wheel automatically cuts off the air. Finally the oil is being fed to cylinders 1, 2, 3 and 4, all these operations being accomplished by turning the hand-wheel. Cylinder compression is 36 kilos per sq. cm., and fuel is injected at 45 to 55 kilos per sq. cm., according to the power developed. Although her Diesel machinery may be considered to be in excellent shape under the circumstances, a new auxiliary or donkey boiler, (for winches, etc.), now is being fitted, as one of the old ones is worn out, which incident hardly needs commenting upon. However, the "France" will be detained in New York for several weeks for this boiler, and for the new cylinders, but as she is a Diesel driven vessel, rumor is sure to go the rounds that she is held up in port owing to the repairs and alterations of her Diesel machinery. It is our aim to make it clear that it is her steam machinery and not her Diesel machinery that really necessitates this delay. Taken as a whole, less trouble has occurred than usually is met with in steam engines and boilers of this power.

Incidentally it may be mentioned that her machinery including propeller, shifting clutches and engine-room auxiliaries, but not including winch boilers auxiliaries only weighs 130 tons, so that here alone there is a most important weight saving, apart from the saving in weight of hundreds of tons of oil-fuel. The maximum total indicated-horse-power of both engines together in the test-bed was 2,610 i. h. p., and the brake-horse-power was 924 i. h. p. per engine, giving an efficiency of about 71 per cent.

Originally she had some luxurious passenger accommodations, the smoke-room alone costing $15,000.00 to equip and furnish, but all this has been torn out and the space used for cargo since the war. Hence she now carries 7,500 tons of cargo, whereas her original dead-weight capacity was 430,000 cubic feet or 6,800 tons.



GUN CREW OF M. A. "FRANCE"

STATES MARINE & COMMERCIAL COMPANY, INC., NEW YORK.

The auxiliary motor vessel "France" is consigned to the States Marine & Commercial company, incorporated, 17 Battery Place, New York, of which Mr. James Donald is the general manager. It is interesting to note that this company has only been in operation for nine months and their business is increasing to considerable importance. They are managers and general agents of the Argonne Steamship Co., Inc., and the Battery Steamship Corporation, as well as of Messrs. Leopold Walford (London) Ltd., London, England. They have already despatched several steamers to France and are operating a regular service of steamers and sailing vessels to South America. In addition they are operating the American SS. "Argonne," a vessel of 9,000 tons deadweight between the Far East and ports in Great Britain.

PENINSULA SHIPBUILDING COMPANY.

The Peninsula Shipbuilding Company, of Portland, Oregon, the builders of the "Esperanca," which was described in Motorship for September, are located on the east bank of the Willamette river, about five miles from the business center of the city. This company was incorporated on June 1st, 1916, and thus became the first shipyard established in Portland for building large wooden vessels. The moving spirit of this incorporation was F. C. Knapp, the president of the Peninsula Lumber Company. He succeeded in interesting some of Portland's most prominent business men who now constitute the board of directors. They are as follows:

A. L. Mills, president of First National Bank; J. C. Ainsworth, president United States Bank; Wm. M. Ladd, of Ladd & Tilton; Theodore Wilcox, president Portland Flouring Mills; Peter Autzen, president Peninsula National Bank; James B. Kerr, Carey & Kerr, attorneys; F. C. Knapp, Peninsula Lumber Company. Officers are: President, F. C. Knapp; vice-president, A. L. Mills; secretary, James B. Kerr.

The shipyard is located alongside the Peninsula Lumber Company, which furnishes all lumber required for the ships (the shipyard utilizes about 20 per cent of the output of the mill). The Peninsula Lumber Company operates their own logging camp thus no delays are experienced in having lumber of all sizes ready for use when required. In this respect the yard has a decided advantage over other shipyards who have to depend upon outside mills for their lumber. The two industries occupy a property comprising 137 acres having a water frontage of 3110 feet and a depth of 2,000 feet. The river depth in front is 30 feet. At present there are four building ways, two of which are covered, and there is room for 12 more. Sheds are to be built over the two outside ways and are to be equipped with overhead traveling cranes. The long finishing wharf paralleling the water front has been constructed with a front face well out to deep water and the company is about to erect a shear legs of ample capacity to lift all machinery aboard the ships. The yard has good rail connections and tracks extend onto the finishing wharf. The company has already launched four vessels of the auxiliary schooner type similar to the "Esperanca." These are now laying alongside the finishing wharf waiting for the arrival of the Winton Diesel engines from the east. The company has a contract with the U. S. Shipping Board for eight steam powered schooners delivery of the first of which will be February 1st, 1918. These vessels are 287 feet long, 48' 8" beam with a depth of 27' 6". Propelling power will be direct gear turbines of 1400 h. p. supplied by Westinghouse Company. Four of these vessels are now on the ways. The shipyard is revising the arrangement of its plant to carry on building operations on a larger scale and is adding to its equipment all the latest shipbuilding tools and appliances. Electric power is supplied for all shipyard machinery. The yard will make a specialty of building completed ships, with all machinery and equipment ready for service.

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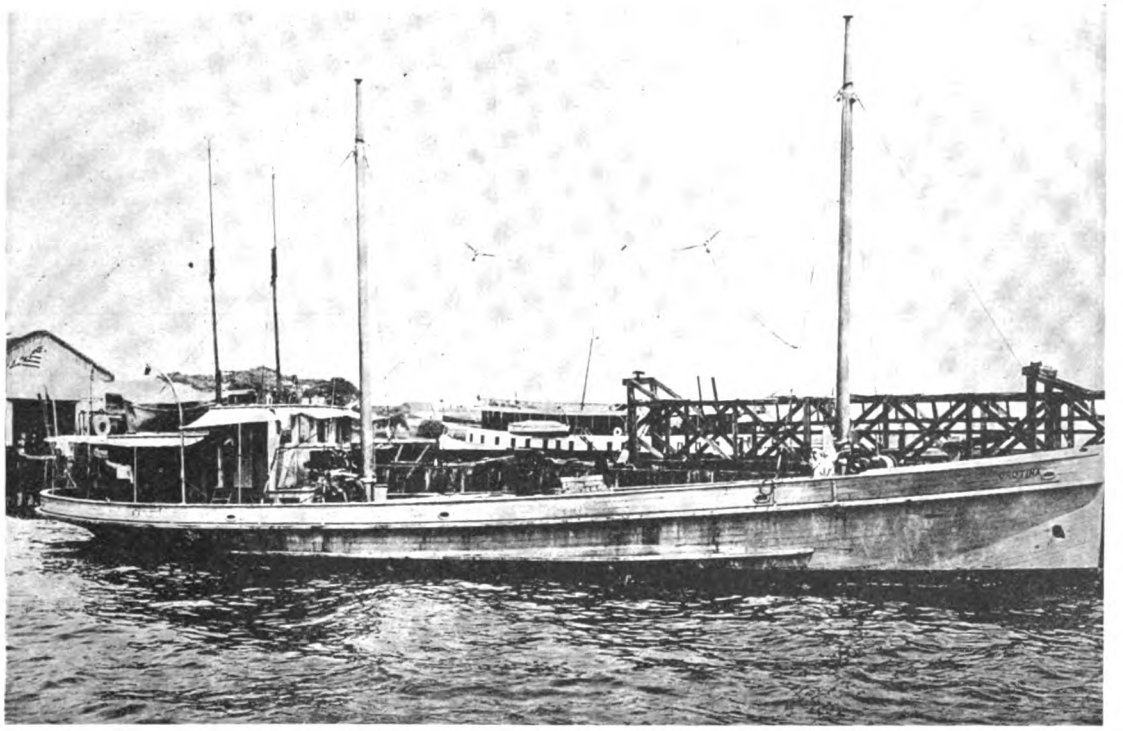
Oil-Engined Freighter for South America

THE heavy oil engined freight boat "Crotina," which has just completed a 2,000 nautical mile trip to the port of Punta Arenas, Costa Rica, Central America from Baltimore, Md., is perhaps the longest voyage ever undertaken by a full powered motor vessel of the size of the "Crotina." She was built by the McLean Contracting company of Baltimore, Md., for Mr. George H. Hepburn of Philadelphia, Pa., who has extensive interests in Central America.



MOTORSHIP "CROTINA"

The "Crotina" is a wooden vessel 92 feet over all, 22 feet beam, 8 feet depth of hold, 6 feet loaded draft, 96 gross and 57 net tons, and has a speed of 8 knots. The boat is of unusually heavy construction.

The engine room trunk is 11'x12' 6"; the pilot house which is above the engine room trunk is 6'x12', a galley 4'x12' is aft of the engine room trunk but adjoining the pilot house. There are two state rooms 6'x6' 9" aft of the galley which contain two fore and aft berths each, the port state room has a toilet 3'x3'. There are two cargo hatches 12'x15', forward of the pilot house, between the masts, each of which has one cargo boom.

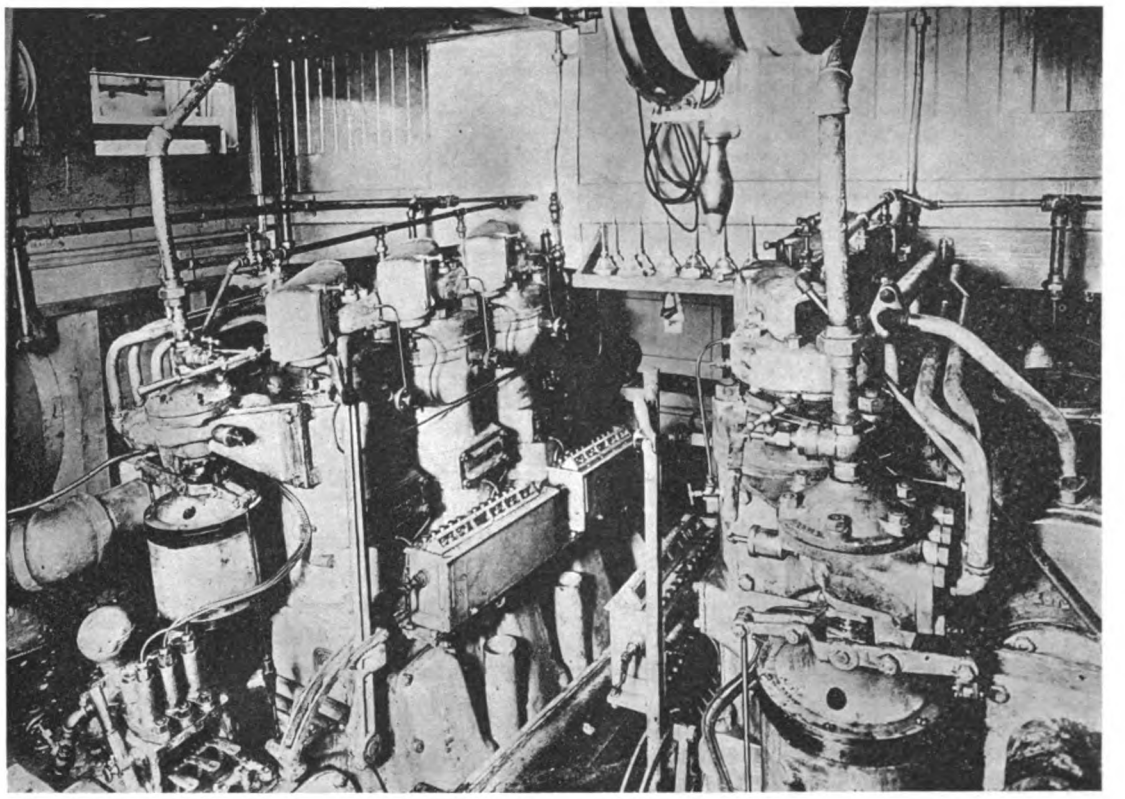
The engine installation consists of two Fairbanks-Morse type C-O surface ignition oil engines, 45 b. h. p. each, 3 cylinders 8½'x10', turning Dyson propellers (36x32⅞) at 400 r. p. m. The weight of each engine with reverse gears is 6864 lbs. The propeller shafts are 2½ inches in diameter. There is a Delco direct connected gasoline-kerosene lighting outfit with 32 volt storage batteries. There are two Fairbanks-Morse single drum hoists, each driven by a type "J" 6 h. p. kerosene engine, the forward hoist being placed forward of the foremast and the after hoist on the engine room trunk forward of the pilot house. There is a double geared windlass on the forward deck, driven by a messenger chain from the forward cargo hoist.

The vessel has five oil tanks with a total capacity of about 800 gallons, three of these are aft of the engine room under deck and one on each side of the engine room trunk well forward and also under deck. One of these last named tanks is used for kerosene for hoists, but can be connected for fuel oil for the main engines if desired.

On the trip to Punta Arenas two cylindrical 4,000 gal. tanks were placed in the forward hatch and piped to engines to make sure that there would be sufficient fuel to take the vessel to her destination. These were removed at Punta Arenas and are now used as storage tanks on shore.

The "Crotina" cleared and sailed from Baltimore, Md., on July 1st for Punta Arenas, via the inside route as far as Beaufort, N. C., thence outside to Miami, Florida; Havana, Cuba, and Colon, Panama; thence through the Panama Canal to Panama City and thence north to Punta Arenas. She was delayed at Norfolk, Virginia. This delay was due to the fact that while going down Chesapeake Bay certain changes were found to be necessary. The engineers also allowed some of the bearings to overheat to such an extent that they required attention. She was then held up by the Navy Department while they made a survey and also was investigated by the Department of Justice.

Notwithstanding the heavy weather that was encountered throughout her entire trip she docked at Punta Arenas in very satisfactory time.



ENGINE ROOM OF "CROTINA"

ITALY STANDARDIZES 8,000 TON MOTORSHIPS.

Italy is to turn out both steel and wooden motorships in large numbers. Already the great naval engineering and shipbuilding company, the Fiat-San Giorgio, Ltd. have laid down a large number of slips at Muggiano (Spezia) and are constructing on them standardized steel motorships of 8,000 tons d. w. c. each, in which they are installing a F. I. A. T.-Diesel type oil engine of 2,200 h. p. on one shaft. They are making bold announcements to British shipowners to the effect that they are offering delivery of these 8,000 tons standardized Diesel-driven motorships in the latter part of 1918.

They also offer to supervise, erect and manage, these motorships for six months. They furthermore are building a number of 2,500 ton wooden auxiliary ships in which they are installing two F. I. A. T.-Diesel engines each of 400 h. p. Incidentally we may mention that the well-known F. I. A. T. automobile is manufactured by a branch of this great Italian concern.

MOTORSHIPS AT BUENOS AIRES.

Even at Buenos Aires they favor crude-oil driven motorships, and no wonder, because local shipowners have before them the three year's record of the little motor vessel "Puerto Ytati," which was built in that city, and equipped with Swedish oil engines of the surface-ignition type. This ship is 150 ft. long, by 27 ft. beam, and 8 ft. draught, and has a cargo-carrying capacity of 600 tons. Her propelling power consists of two Avance marine reversible motors, each developing 150 b. h. p. at 240 revs. per minute. The loaded speed is 9 knots, and the trial speed is 10 knots.

There also is a sister motorship in operation, which was put in service several months after the "Puerto Ytati." There also is in service the converted steamer "Namuncura," which was driven by two Avance crude-oil motors.

THE LARGEST MOTORSHIP.

One of the largest Diesel-driven motorships in the world is "resting" in Germany. This is the "Wilhelm A. Riedermann," a tanker owned by the German-American Petroleum Co., (a branch of the Standard Oil Co.). Just at the outbreak of the war this ship was nearing completion. She is 525 ft. long, with 66 ft. 3 inches breadth, 41 ft. 3 inches moulded depth, and has a deadweight-capacity of 15,000 tons on a draught of 27 ft. 9 inches. Her Diesel engines were built by Krupp and each developed 2,000 b. h. p. at 125 r. p. m. or equivalent in aggregate to about 5000 "steam" indicated horse-power. The speed was to have been 10½ knots when loaded.

MOTOR CANAL BOAT, "CARL PEDER."

The motor canal ship "Carl Peder," which was launched from the yards of Vansburg, Tosse, Sweden, in July is powered with a motor burning crude oil which develops 250 b. h. p. She is of 750 tons and was built for the Baltic trade.

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Fuel Oil for Oil Injection Engines

The Action of the Fuel Oil in the Cylinders of the Engines

Motorship with the permission of the Standard Oil Company is enabled to reprint the following copyrighted article taken from Bulletin No. 7, prepared by the Fuel Oil Department. This Bulletin was prepared to present a comprehensive scientific statement of the required properties of an oil as a fuel for Oil Injection Engines and the action of this oil in the cylinders of the engine. The clarity of the charts make it very valuable for reference.

THE Oil Injection Engine was invented by Dr. Rudolph Diesel and the original specifications were dated August 27, 1892. The cycle of operations in a single-acting four-cycle engine is shown in Plate I and is as follows:

First Stroke: Cleaned air is drawn into the cylinder and is represented on the pressure volume diagram in plate 1 by a. b.

Second Stroke: The air is compressed to a pressure varying between 400 to 600 lbs. sq. inch. At these pressures the temperature of the cylinder is between 900° F. and 1200° F. This is shown on the pressure volume diagram by line b. c.

Third Stroke: The fuel oil is atomized and injected into the cylinder, combustion taking place. This injection usually continues during 10 per cent of the stroke on full load, and may be varied by adjusting the valve. After cut-off, expansion of the gases takes places. Just before the end of the stroke the exhaust valve opens and the pressure drops rapidly. The injection of fuel oil is shown on the pressure volume diagram by line c. d., the point of cut-off being at d. The expansion line is shown by d. e., the point of opening of the exhaust being at e.

Fourth Stroke: The gases are exhausted into the atmosphere. This is shown on the pressure volume diagram by line e. f.

In Dr. Diesel's original specification, during the injection of the fuel oil in the third stroke, it is specified that the fuel oil shall be injected at such a rate that the heat produced by combustion shall be expended on work done on the piston, so that there will be no rise of temperature in the cylinder. This is known then as the constant temperature cycle and is shown on the pressure volume diagram by a, b, c, d, e.

It has been proved that the constant pressure cycle is more efficient and most engines are now designed to operate on this cycle. In the constant pressure cycle, the fuel oil is injected at such a rate that the heat produced by the combustion shall be sufficient to do work behind the piston diagram for the constant pressure cycle is shown in Plate I and marked a', b', c', d', e'. In this cycle there is a considerable raising of the temperature, the maximum temperature occurring and to keep the pressure constant in the cylinder during the injection of the fuel. The indicator about one-third of the stroke.

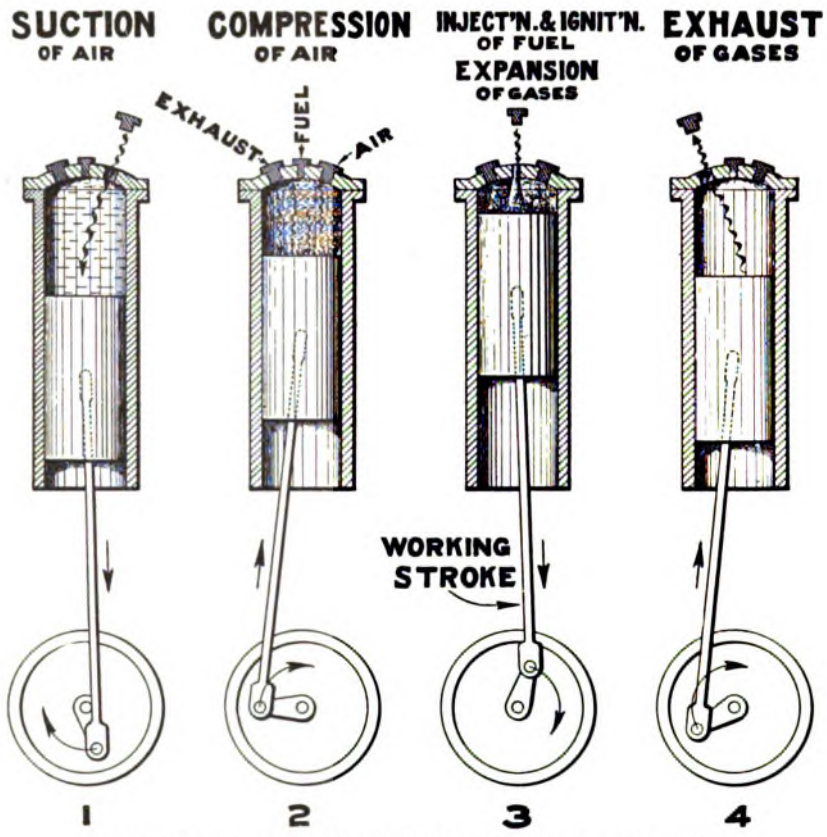

PLATE I—CYCLE OF OPERATIONS OF FOUR-CYCLE DIESEL ENGINE

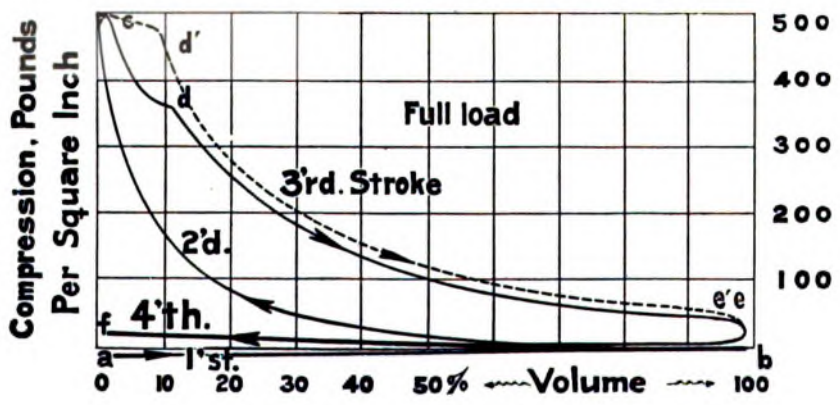

PLATE II—TYPICAL INDICATOR CARD

There is another type of oil injection engine which obtains the temperature for ignition on the second stroke by means of a hot bulb or hot cylinder head, which, on starting, is heated to proper temperature by outside means. When the engine is in operation, the cylinder head or hot bulb is maintained at sufficient temperature by the heat of combustion of the fuel.

The compression pressure in the cylinder on this type of engine varies from 100 to 200 lbs. per square inch.

Technical Considerations.

In carrying out the Diesel cycle the fuel must be pumped readily from the fuel oil storage tank to the small measuring and distributing pump on the engine. Therefore to be pumped easily there must be a limitation to the viscosity of the oil.

Viscosity: The viscosity is the relative fluidity of the oil. It is determined by measuring the time taken for the oil to flow through a standard size tube under standard conditions. The result may be expressed as specific viscosity compared with water at 77° F. (25° C.).

$$\text{Specific Viscosity at T°} = \frac{\text{Seconds for passage of given volume at T°}}{\text{Seconds for passage of same volume of water at 77° F. (25° C.)}}$$

Effect of Heat upon Viscosity: Viscosity decreases upon the application of heat. Plate II shows the viscosity of calol fuel oil under different temperatures when measured with an Engler Viscosimeter. It can be readily pumped at normal temperatures, though the viscosity decreases rapidly with increase of temperature.

Atomization: The oil is pumped by the distributing pump to a spray valve, where it is atomized and injected into the cylinder. Atomization is the breaking up of the oil into small particles, to increase the exposed surface of the oil so that the rate of distillation and chemical activity of the oil may be increased, and the combustion of the fuel accomplished in the time given by the design of the engine. The time for injection in an engine running 300 r. p. m. is 1/100 of a second and the probable time of burning is 3/100 of a second.

As the object of atomization is to present a large surface to the action of heat and air to obtain chemical activity, the surface tension of oil must be overcome.

Surface Tension is a force which causes a liquid particle to have the largest volume for the smallest surface, or a force which makes liquid particles assume a spheroidal shape. The surface tension of the oil and effect of temperature upon the surface tension appears in Plate III. It will be seen that surface tension decreases with temperature.

The energy for atomization is supplied either by compressed air or mechanically. Compressed air is generally used in the high compression type of engines and mechanical atomization is generally used in the lower compression or hot bulb type, although in this type compressed air is sometimes used.

Injection: To inject the oil into the cylinder after it is atomized the particles must be given kinetic energy, therefore the pressure of the spray must be greater than the pressure in the cylinder.

The Action of Fuel Oil in the Cylinder.

When the oil is sprayed into the cylinder the action of each particle is as follows:

First: It is distilled under the pressure in the cylinder. This pressure raises the distillation point of each fraction over the distillation point at atmospheric pressure. As each fraction is distilled it combines with the air and combustion takes place.

Second: The high boiling compounds are generally "cracked"—that is, formed into lower boiling hydrocarbons, tar, free carbon and a fixed gas. The free carbon and tar will burn if there is sufficient temperature, air and time. If there is too large a quantity of high boiling compounds or if the oil is not atomized finely enough there may not be sufficient time or temperature to distill or "crack" these compounds or to burn the tar and free carbon, and these compounds, which are heavy and sticky, become deposited on the exhaust valve, which makes the valve "stick," or prevents it closing properly, thus losing compression, temperature and efficiency, and scoring the valve and valve chamber.

Therefore the amount of high boiling compounds which are known as Asphaltum should be limited. To determine precentage of Asphaltum, 50 grams of oil are weighed in an evaporating dish 2⅜" in diameter by ¾" high, placed in an oven heated to a temperature of 400° F.

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(204.4° C.) and maintained at that temperature until the residue has a penetration of 80° as determined by a No. 2 needle, weighted with 100 grams, for 5 seconds at 77° F. (25° C.).

Economic Considerations.

In selecting an oil, consideration should be given to its economic properties, such as gravity, calorific value, percentage of sulphur and flash point.

Gravity: Gravity is the weight of a substance per unit volume and with oils is measured on two scales, specific gravity and Baumé.

Specific gravity is the ratio of the weight of the oil to the weight of an equal volume of water and is generally used scientifically.

Baumé gravity is an arbitrary scale which has a definite relation to the specific gravity scale and is generally used commercially. It consists of two scales; one graduated for liquids heavier than water, and the other for liquids lighter than water. Each scale is graduated to 100°, and overlaps 10°.

On the scale for liquids lighter than water

100	equals a specific gravity of	0.6087
10	" " "	1.0000
0	" " "	1.0769

On the scale heavier than water

0	equals a specific gravity of	1.0000
10	" " "	1.0741
100	" " "	3.2222

For liquids lighter than water

$$\text{Specific gravity} = \frac{140}{130. \text{ plus Reading Baume}}$$

For liquids heavier than water

$$\text{Specific gravity} = \frac{145.}{145. \text{ less Reading Baume}}$$

With calol fuel oil the scale for liquids lighter

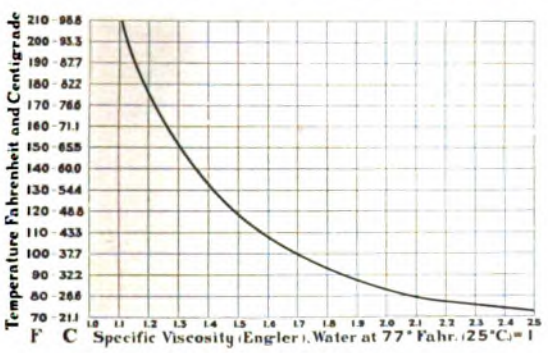

PLATE III—VISCOSITY—TEMPERATURE CURVE

than water is used and the gravity is determined conveniently by means of a hydrometer.

Economically considered, the gravity is of importance in connection with the calorific value.

The calorific value is usually measured in heat units per unit of weight. Lighter oils generally contain more heat units per pound than heavier oils, but less per barrel, as the heavier oils contain more pounds per barrel and the rate of increase of weight is greater than the rate of increase of calorific value. Calol fuel oil is sold by the barrel and will contain more heat units per barrel than lighter oils.

The Effect of Temperature on Gravity Readings: The weight of oil per unit volume, such as pounds per barrel, or in other words, gravity, alters under variations of temperature, becoming lighter with an increase of temperature and heavier with a decrease of temperature. The effect of temperature on gravity readings is shown on Plate IV. The plate is read as follows: If the gravity reading is 26° B. and the temperature

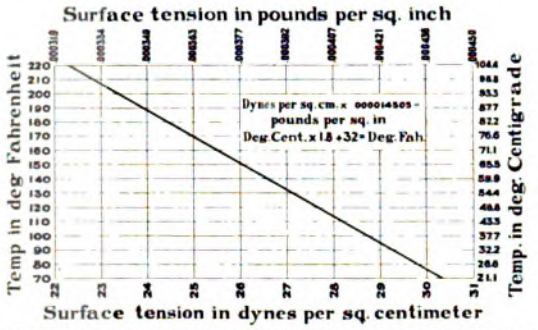
Surface tension in pounds per sq. inch
Temp. in deg. Fahrenheit
Temp. in deg. Centigrade
Dynes per sq.cm. x .000014505 = pounds per sq. in
Deg.Cent. x 1.8 +32= Deg.Fah.
Surface tension in dynes per sq. centimeter

PLATE IV—SURFACE TENSION—TEMPERATURE CURVE

is 93° F. (33.9° C.) the intersection of the vertical and horizontal lines of these two figures is seen to be on the 24° B. curve, which is the correct reading at 60° F. (15.6° C.)

The Effect of Temperature on Volume: The volume of oil alters with temperature. For this reason calol fuel oil is sold at a standard temperature of 60° F. (15.6° C.) or with its volume measure corrected to 60° F. (15.6° C.) by the following formula:

$$\text{Volume at } 60° \text{ F. } (15.6° \text{ C.}) = \frac{\text{Volume at T°}}{1 \text{ plus } 0.0004 \ (T - 60)}$$

Calorific Value: This is a measure of the heat units in the oil and is expressed as British

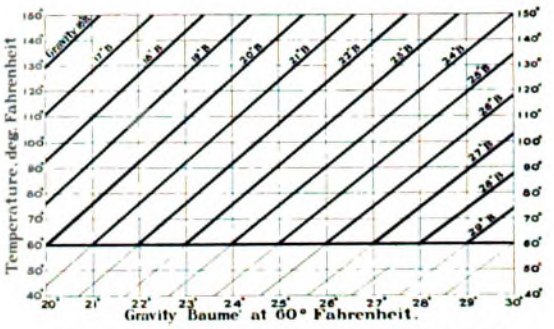

PLATE V—GRAVITY CORRECTION CURVE FOR TEMPERATURE

Thermal Units (B. T. U.'s). The B. T. U. is the amount of heat required to raise 1 pound of water 1° F. Calorific value is determined by means of the bomb calorimeter.

Sulphur: Sulphur in the oil must be limited, for it is found that if the amount is too great, pitting of metal may take place, due to the formation of sulphurous and sulphuric acids. Fuel oil with a percentage of sulphur up to 1 per cent has been used and found to be entirely satisfactory.

Flash Test: This test is an indication of the temperature at which the oil gives off vapors which form an inflammable mixture. It does not indicate the value of the oil in its use in the engine.

It is important that a relative safe flash point be used so as to reduce the fire hazard for storage or transportation purposes. The U. S. Government, in its specifications considers 150° F. (65.6° C.) as a safe flash point.

The flash point is determined in a flash tester.

Characteristics of Calol Fuel Oil.

After consideration has been given to the technical and commercial features of an oil for oil injection engines, the Standard Oil Company of California is prepared to offer for use in these engines calol fuel oil having the following characteristics:

Gravity, degrees Baume at 60° F. (15.6° C.)	24° B. plus
Specific gravity at 60° F. (15.6° C.)	0.91 —
Weight per U. S. gallon of 231 cubic inches	7.586 plus lbs.
Viscosity	approximately 4 Englers at 77° F. (25° C.)
Percentage of Asphaltum	approximately 25%
Calorific Value (B. T. U. per lb.)	approximately 19,000
Sulphur	approximately ½ of 1%
Flash Point (Closed Cup)	not less than 150° F. (65.6° C.)
Water and non-petroleum sediment,	approximately 0.5%

NEW PANAMA CANAL SUPPLY BOATS TO BE EQUIPPED WITH NLSECO 120 B. H. P. ENGINES.

The Panama Canal has placed in service at each terminal a supply boat, designed and built at the Balboa shops, especially for delivering supplies to ships. The cargo hold of each boat has a capacity of about 20 tons, and rigging is erected on the forward deck to handle the loading and unloading of goods. The boats are equipped with Diesel engines which are expected to give the vessels a speed of 7 miles per hour, but have been found to develop a speed under moderate load, of 9 miles. These boats are 85 feet over all; 75 feet on the water line; 20 feet of beam, moulded; 9 feet moulded depth; 5 feet 6 inches draft; 140 tons displacement. The forepeak is used as a fuel-oil tank with a capacity of six tons of heavy oil. The engines consume less than a gallon of fuel per mile giving the boats a cruising radius of 2,000 miles. Abaft the fore-peak is the chain locker and the hatch to the storerooms, port and starboard; these storerooms will contain small articles sold to sailors on vessels passing through the Canal. The cargo hold has a capacity of about 20 tons and will stow provisions in crates to be sold to vessels. A fresh water tank of 50 tons capacity, built between the machinery space and the cargo hold, will supply fresh water to vessels. In addition to this main tank, the after peak is arranged as a water tank with a capacity of 20 tons, and is piped so the two tanks can discharge water to each other or to vessels alongside.

The power plant of these boats consists of a Diesel engine of 120 b. h. p. operating at 350 r. p. m., built by the New London Ship & Engine Company. It drives a propeller 50 inches in diameter by 30 inch pitch. The auxiliary outfit consists of a 24 horsepower, 4-cycle Palmer engine operated by gasoline, connected by clutches and belts to an air-compressor, 3-kilowatt dynamo, a centrifugal pump, and bilge pump, all attached to one bed-plate. Accommodations for the crew are provided in the main deck house and consist of galley, mess-room, chief engineer's stateroom, and quarters for five men with toilets and shower spaces for officers and crew. At the forward end of this house is a cold-storage compartment, insulated with cork. It is capable of storing 21 blocks of ice and 9 quarters of beef and in addition such articles as are generally placed in cold storage. Cargo grating is placed over the steel deck forward of the house to provide storage for 20 tons of provisions, in addition to the 20-ton capacity of the hold. A small house on the bridge deck provides quarters for the captain and commissary clerk, forward of which are the steering wheel, binnacle, etc.

A mast, boom, and rigging with a simple hand-winch are arranged to lift a load of 1,200 pounds 35 feet above the water. This height is necessary to land cargo on the decks of vessels, and also to stow cargo aboard the supply boat when alongside the wharf at Balboa at low tide, where there is a difference of 18 feet between high and low water.

The doors and window sash throughout are of teak; the boat is well ventilated and lighted, and considering its dimensions, embodies characteristics not often seen in vessels of its size. These vessels are expected to prove very useful in the work for which they were designed. They are being used as light tow-boats in addition to their other duties.

MORE VESSELS TO BE MADE MOTORSHIPS.

The British steel barge "Dolbardarn Castle, ex Earnmount," has been sold by R. Thomas & Co., of Liverpool, to the Anglo-Saxon Petroleum Co. for conversion into a motor-tank-ship. This vessel is of 3,400 tons dead-weight-capacity, 1,860 tons register, and was built at Port Glasgow in 1897. Length 267'x40' 1"x23' 5".

The British ship "Celtic Glen" also has been sold for conversion into a motorship. Her owners were Hughes, Jones & Co., Ltd., of Liverpool. She is of 3,100 tons d. w. c., 1,859 tons register, and was built at Port Glasgow in 1892. Both vessels, it is understood, will be installed with Werkspoor-Diesel engines.

SOME SHIP!

Although of only 6,460 tons d. w. c. the B. & W. Diesel-driven motorship "Kangaroo," ex "Lalandia," has a hold capacity of 300,000 cubic feet of ordinary cargo, or 320,000 cubic feet of grain, without interfering with the fuel bunkers of 90 days full-power operating. She maintains a speed of 11 knots on a total fuel-oil consumption including auxiliaries of about 50 barrels per 24-hour day. Her exact consumption including auxiliaries is 0.292 lbs. per i. h. p. per hour. Such figures as any of the above would be impossible with any class of steamship. She was built in Great Britain.

MISSIONARY SCHOONER MAKES ANNUAL TRIP.

The Bender Bros., one of the original power schooners of the Coast sailed at the beginning of the month for the Bering Sea missionary stations along the Alaskan coast. She goes as far north as Point Barrow, in the Arctic Ocean and if possible returns to San Francisco by early winter. Sometimes, however, she misses connections. Last year, for instance, the little craft was caught in the ice to remain there all winter. She made the most of her arctic confinement and returned home this spring bringing several cases of furs, also ivory and whalebone obtained by hunting during the winter and from the Eskimos on the mainland.

NEW MOTORSHIPBUILDING YARDS.

At Norrkoping, Sweden, a new motorshipbuilding yard has been completed. Cargo motorboats of 725 tons d. w. c. are to be built. The intention of the owners is to undertake the building of large ships by degrees. A floating dock for good-sized vessels will also be constructed. A new yard of a similar nature is to be built at Korsoer, Denmark.

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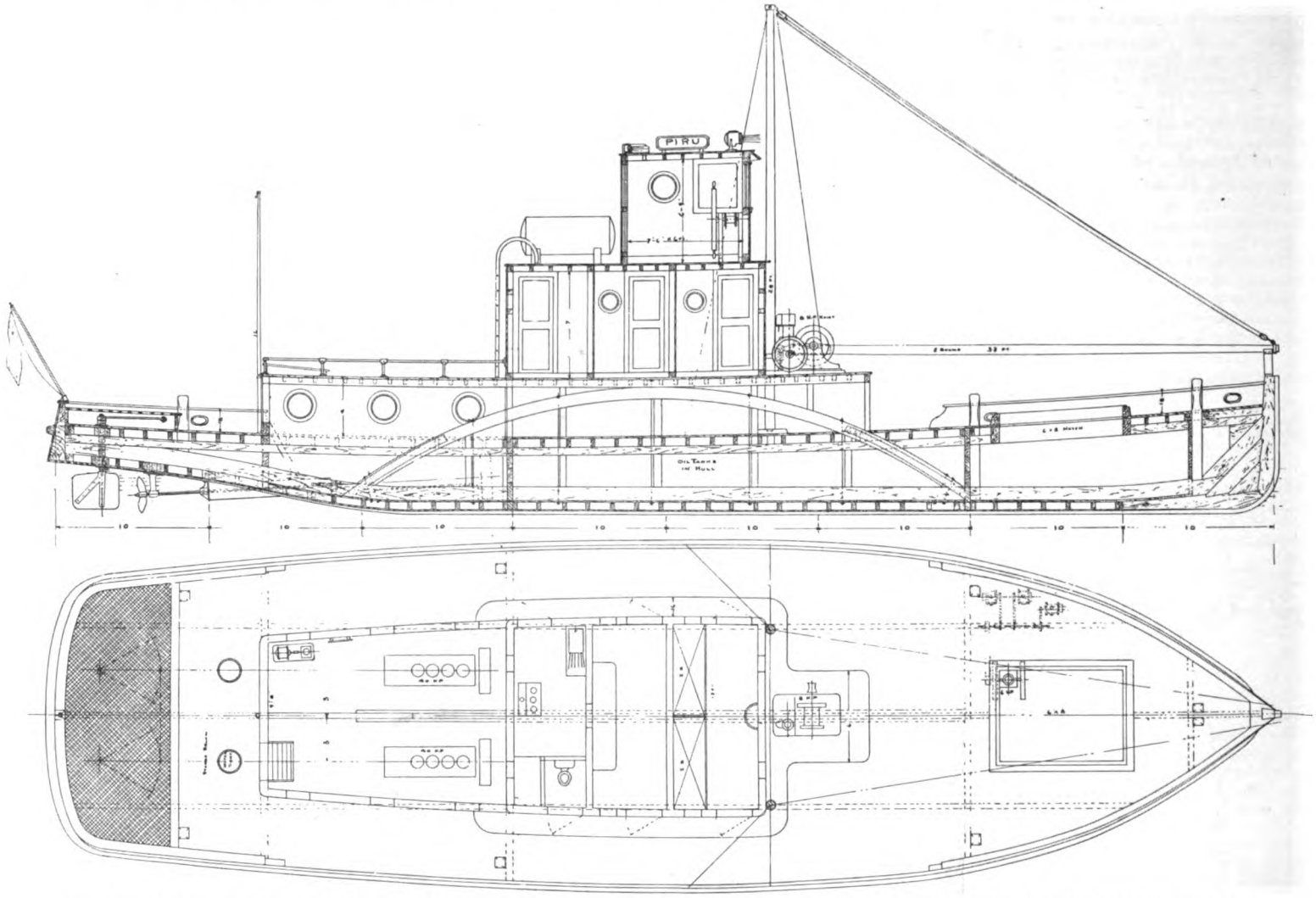
Motor River Boat for Union Oil Company



THE "PIRU," OWNED BY THE UNION OIL COMPANY. 80 FEET LONG, 22 FEET WIDE AND POWERED WITH TWIN 60 H. P. WISCONSIN MOTORS.

Fellows and Stewart, formerly the Joe Fellows Yacht and Launch company of Los Angeles, have recently completed at their yards a large oil delivery boat for the Union Oil company. An illustration of the boat is printed herewith. She will be used on the Sacramento river. The boat is 80 feet long, has a beam of 22 feet and will be driven by twin screws. The boat will be equipped with two 60 h. p. Wisconsin motors. She is to have a solid chime log, and the log is rabbeted to receive the planking. The frame is of Oregon pine, the knees being of oak. The frames are 3 ft. by 6 ft. and set to 18 in. centers. The oak knees are bolted to each frame and also to the chime. The keel is 4 ft. by 10 ft. in size, the stem being 8 ft. by 16 ft. and the garboards 4 ft. by 12 ft. The planking is 3 inches thick.

The cargo space provides for 10,000 gallons of distillate, 3,000 gallons of gasoline, 50 barrels of kerosene, 10 drums of stove oil and 120 cases of refined oil.

The Fellows and Stewart plant has recently been enlarged so as to handle craft up to 250 feet in length.

SHIPPING BOARD ARCHITECT NOT OPPOSED TO DIESEL ENGINED SHIPS.

Theodore E. Ferris, chief naval architect and consulting engineer for the Emergency Fleet Corporation, believes the stand he has taken in the matter of the steam engine versus the oil engine as a means of propulsion for seagoing vessels has been generally misunderstood.

In an interview with a member of the editorial staff of the Evening Mail recently Mr. Ferris stated:

"I believe in the motorship and have great faith in its future, but the fact remains that no American has as yet built a reliable, dependable and altogether successful internal combustion engine for ships designed for the transatlantic trade.

"Such engines have been built abroad, and I believe they have turned out to be very satisfactory and highly desirable. The Diesel engine, as turned out by Werkspoor and Burmeister & Wain, represent a thoroughly efficient means of motive power.

"Nothing that approaches these engines has been built in America, however, and we are still in the experimenting stage. So far we have not turned out a marine oil engine that has demonstrated that it could stand the wear and tear of transatlantic service. This service is the real test of a ship's machinery.

"When we build an ordinary tramp cargo steamer we know that she can put to sea and keep her engines running for forty-five days if necessary. We must know from actual experience that we can put the internal combustion engine to the same test before the motor ship can attain recognition as a reliable commercial proposition.

"I have inspected the motorships 'Hamlet' and 'George Washington,' both engined with foreign-built Diesels, and there is no doubt in my mind that they represent the most economical and generally desirable type of merchantman.

"We lack the engineers and the experience to build such vessels as the 'George Washington' and the 'Hamlet.' Our engines, for the most part, have been built on theories. The foreign-built Diesels employed in the successful motorships have been built on actual, sea-going experience.

"We have not had that experience and the war has interfered to a great extent with our obtaining it. The war has prevented us from taking advantage of all that great German, Belgian and Scandinavian engineers know about the Diesel engine.

Experience Lacking.

"I don't want to cast any reflections on American ship and engine builders, but it is a fact that they haven't had the experience necessary to turn out a motor that measures up to those built abroad, and they have achieved no success thus far in the construction of large powers.

"The best experience shows that in these large powers there is a heat element that tends to crystallize the cylinder heads and walls and give trouble. This is only one difficulty that must be overcome.

"We must learn these things from the experience of the foreigners. It will be necessary for us to bring to this country German, French and Belgian engineers in order that we can get the benefit of their years of experience in motor building.

"If we are going to have motorships we must have men to run them. The personnel of a motorship is much higher grade than that of a steamer. You can find ten men who can run a steam engine while you are locating one who can handle a Diesel. This is one of the big reasons for adopting steam as the power for the emergency fleet.

"In addition to this there is the fact that many of the emergency ships were to be of wood, and when figuring on power it was necessary to keep the vibration down to a minimum.

"There is far more vibration from an internal combustion engine than there is from one driven by steam.

"The oil engine under ideal conditions works ideally, but when these conditions change there is trouble. There may be built in this country at some future time a motor that will stand up and meet the requirements of the transatlantic service, but I am afraid that time is a long way off.

"I knew what steam would do. I didn't know what an American-built internal combustion engine would do. I did what any experienced man would have done and chose the steam engine."

APPEALS TO LICENSED MARINERS.

The United States Shipping Board Recruiting Service, of which Henry Howard is director is undertaking a country-wide census of licensed mariners, in order to deal with the present emergency. The board is urging all licensed mariners who are engaged in shore occupations to come back to the sea, for the new Merchant Marine will need great numbers of competent men.

There are about 40,000 licensed officers. Many are not now engaged in the sea-faring profession. It is to these men of considerable sea experience that the board is making its appeal.

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Pioneers of the Oil Engine Industry of the United States

No. I—MR. CARL W. WEISS

FROM its earlist infancy the development of the internal-combustion oil-engine—particularly the marine field—has been a most fascinating subject to those concerned, despite the severe blows that many of the pioneers have suffered from time to time. The more difficult and baffling the problems that have had to be overcome, the deeper grew the interest, and the more tantalizing the solution, the greater the satisfaction when reached.

A man who has spent nearly half a lifetime probing and grappling with a thousand and one complex and problematical points, that arose and varied with every increase in power and under every different condition of operation, is Mr. Carl W. Weiss, late of Meitz & Weiss, and now associated with the newly formed Weiss Engine Co.

Mr. Weiss has devoted his efforts very largely to the low-compression surface-ignition class of oil-engine, which often is erroneously termed semi-Diesel motor, and is a great believer in that type in preference to the true Diesel engine, and it is this class of motor that his new company now is engaged upon.

Mr. Weiss was born in 1858 in Sophienthal in the Dukedom of Nassau, Germany, and in 1865 his father took him to Koenigsklinger Au, an island in the Rhein near Eltvill, and it was his good fortune and privilege later to enter the college in Erbach of the late Princess Marianne of Holland, daughter of William II. This institution was founded, equipped and maintained by the Princess in memory of her son. The laboratory in Physics was considered one of the best equipped in Nassau at that time.

In 1876 he visited the Centennial Exposition in Philadelphia, Pa., and for the first time saw there the Otto Langen free piston type gas-engine in operation. During several years following, Mr. Wiess was with the Benton Manufacturing Company in New York City, building experimental models of all descriptions, mostly patent-office models, which were then required in the United States Patent Office, for the most machinery and mechanical devices. Among these models might be mentioned Edison's first talking machine, which was sent to the Paris Exposition.

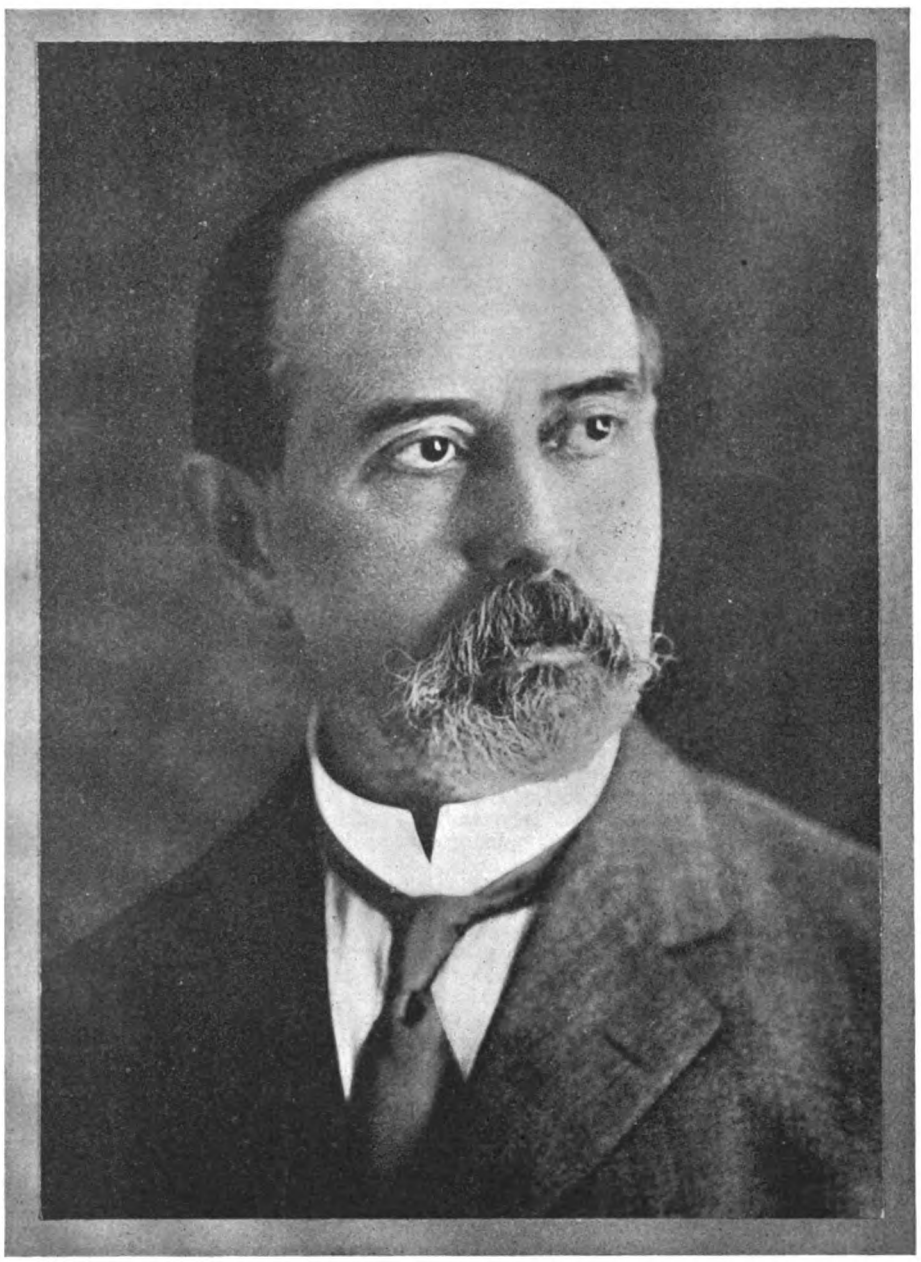
The two years following he had charge of the Nanau & Bendit plant, manufacturers of all kinds of press work. About this time and in connection with several of his U. S. patents on thermo-electric registering machines, he made the acquaintance of Professor Van DerWide, Professor Plymton, Professor Fritz, and others in his experiments on Selenium Cells.

In the early 80's he perfected and manufactured a mechanical register and adding machine for the Check and Adding Machine Company of New York. During this time and several years following, he built a large number of caloric engines both of the atmospheric and high pressure type.

In 1888 Mr. Weiss built his first internal-combustion turbine, and although this was not successful, he has never abandoned the idea, and it is his opinion that this type of turbine, with super-heated steam as one of the working mediums, is bound to supersede the piston engine, especially in the larger sizes.

The register business, including his patents and die casting method, having been sold to the National Cash Register Company, of Dayton, Ohio, in 1889, he devoted his entire time to internal-combustion-engines. Among the many models of his atmospheric engines, there was one particularly interesting, and we mention it here because it demonstrated the excellent thermal efficiency possible in that type of engine. Only 1" bore and 1½" stroke, this little engine could easily be held in the hand while running 4,000 r. p. m. A gas-burner located at the cylinder head and controlled by a slide-valve furnished the flame burning directly into the cylinder under atmospheric pressure during the outstroke of the piston.

During the first demonstration of this model at Stevens institute, Professor Denton refused to believe that the high speed could be explained by the cooling of the products of combustion, until the substitution of a "parlor-match" for the gas burner set the engine going at a lively rate. He



CARL W. WEISS OF THE WEISS ENGINE COMPANY

built a number of this type, one of 8" bore and 20" stroke, furnishing power for a machine shop on 26th Street, between 9th and 10th Avenues, New York.

The first Weiss four-cycle type engine was built about this time, and a number were sold in New York City, and several of them are said to be in operation today.

In 1894 he completed a two-cycle type engine known as the Mietz & Weiss oil engine. In the small horsepowers there were sold in the first few years about 2,000 engines. Most of these first engines are in regular service today. The first 10x12 horizontal engine of this type went to Woreth Brothers, 319 Jerome Street, Brooklyn, N. Y., in 1897, and is furnishing power there today in a satisfactory manner. The repair cost of this machine has been about ¼ of 1 per cent per annum. The increase in both domestic and export trade kept the factory busy for many years on small and medium sizes.

There have been manufactured and sold about 10,000 of his engines, caloric-internal-combustion, and two-cycle Mietz & Weiss oil engines, up to 100 h. p. single-cylinder units and 2, 3, 4 cylinder stationary and marine engines from 3 to 200 h. p. units in all parts of the world. Finally we will add that Mr. Weiss is a member of the A. S. M. E., American Association for the Advancement of Science, and the Legion of Honor of France.

HENDRICKS MANUFACTURING COMPANY

The manufacture of heavy oil engines and the demand for parts has made necessary the expansion of several machine shops in the Pacific Northwest and particularly in the vicinity of Puget Sound.

Among these is the long-established firm of Hendricks Manufacturing Company of Seattle. This company started operations in Seattle in 1903 and since that time has been engaged in general machine work. With the development of the heavy-oil engines and the designing and building of several successful engines of this type in this vicinity this shop began to receive orders for parts. For the last eight months three shifts have been working at the old location, turning out screws, studs, and special bolts. Their business has been steadily increasing and as a result it was decided to build upon a tract of land acquired by them, and building was commenced immediately.

The new plant covers one-half of the tract being 100 feet by 150 feet—the remainder will be built upon as soon as conditions permit. A heavy concrete floor has been laid and the building itself is constructed of very heavy timbers. The company plans to build heavy marine equipment of various kinds. It is well lighted by windows placed on all sides. A ten ton Curtis crane running the entire length of the shop has been erected. This can and will be supplemented later by heavier ones. A complete line of machine tools for the making of machine screws is among the new equipment. Four Jones and Lamson turret lathes and Brown and Sharpe grinders are also installed. The plant cost $75,000.

Mr. J. J. Hendricks has associated with him his two sons, W. J. and E. A. Hendricks.

DIESEL ENGINE IN THE "DEFIANCE"

A Nlseco-Diesel engine 150 b. h. p. has been installed in the old cup defender "Defiance." This engine is not one of the latest four-cycle motors built by the New London Ship Engine Co., but is of the old two-clcye design.

CHARTERS MOTORSHIP "TEMPLATE."

W. R. Grace & Co., of San Francisco, have chartered the motorship "Template" to carry a cargo of redwood lumber to South America. After the finishing touches have been placed on the "Template," she will go to Eureka to load, and sail for the south from here. The "Template" was built by the Columbia Engineering Co., of Linnton, Ore., and launched there on June 15.

RAPID SHIP CONSTRUCTION.

The first of the British standardized 5,000 ton steel ships was put in commission after most successful trials at the end of August. This ship was laid down in February and launched in June. We wonder if she is one of the standardized motorships?

THE NORDSTJERNAN JOHNSON LINE.

The Nordstjernan Johnson Line has now a fleet consisting of 7 motorships and 14 steamers.

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Full-Powered Motorships: Their Economy and Future

By JOHN W. MORTON, M. E.

(Concluded)

THOUGH the direct combustion of the fuel in the working cylinder has rendered an increase of the thermal efficiency possible, nevertheless a great amount of heat is lost. It has been shown that to avoid cracks in the cylinders and special cylinder heads an energetic circulation of water is a necessity. For cooling, either fresh or salt water or oil may be used, but the question which cooling medium should be used still exists. Without a doubt fresh water is the most suitable. This, if used, of course will have to be produced aboard, and also means for cooling it to use over again, before it enters the cylinders.

Some attempts have been made to utilize some of the 60 per cent loss resulting from the Diesel process. Exhaust gases have been applied directly to heat the donkey boilers and also to heat the ship by special apparatus. Pre-heating the fuel oil in the tanks by means of the cooling water (heated by the motor) has its disadvantages, for, through leakage in the pipes, water will become mixed with the oil, which of necessity must be avoided. The fuel oil itself contains some water which takes from ten to twelve hours to be precipitated.

The fuel oil consumption can be estimated at about 0.40 lbs. per b. h. p. hour for motors ranging from 1,000 to 1,500 h. p. With a value of 18,000 b. t. u. per pound of oil this means a heat consumption of 7,200 b. t. u.'s per h. p. hour. With a thermal efficiency of 35 per cent plus 10 per cent for friction losses, 3,240 b. t. u.'s are available for actual service in the working cylinders and the remainder 55 per cent or 3,960 b. t. u.'s lost through the exhaust, cooling water, and radiation. If the b. t. u.'s which are lost were transferred into coal we would get a good-sized daily consumption for a small plant. In view of this fact engineers have tried to reduce the heat loss to a minimum. Notwithstanding these things, these methods owing to the double nature of arrangements should be dissuaded in ship traffic. The trend of the times is to exclude steam-power in motorships. Ship owners have as yet deemed it inadvisable to do away with the auxiliary boiler used for the windlasses, the steering-gear and the heating plant. Some motorships have had installed hydraulic auxiliaries together with steam air and electricity. Many motorships have electric auxiliaries alone, which the writer thinks to be the best and the most economical, especially in cargo vessels. This is the type used on the motorship "Tiania," built by Burmeister & Wain (4,000 h. p.). The donkey boiler which is on board this ship is used in heating the passengers' accommodation and the bath water. It is purely a convenience.

As mentioned previously (under causes of cracks developing in cylinder heads) the difficulties of cooling is again referred to, when the mean temperature is temporarily increased. These same difficulties arise when the diameter of the cylinder increases. With a linear increment, the volume increases in the third power, the radiating surface only in the second power.

The steady evolution of the four-cycle motor has made it possible to reach a cylinder diameter of from 28 to 31 inches as a maximum. It has been practically demonstrated that the problem of construction as well as that of cooling has been solved. Manufacturers making four-cycle motors, who from the beginning have had high hopes, and who in fact have taken the lead in these matters, have dearly paid for their experiments. At the time of writing, however, many companies have made great progress along these lines with future promises of successful designs. Motors with a cylinder diameter of 48 inches have worked successfully on the test block.

As is known, the methods of fuel injection and reversing are accomplished by means of high-pressure air. The apparatus for producing this high-pressure air makes the construction of the motor more difficult and complicated. The steady supply of air sufficient and available at all times, in case of maneuvering, demands special attention. For this purpose air-compressors were introduced. These are connected directly with the main motor or are driven from special power plants. The local conditions determine which method to be used. Such an outfit consumes about 10 per cent of the power produced and takes up considerable space. The direct coupled compressor, notwithstanding several disadvantages, is used very much.

On the construction of an ideal compressor, suitable for ship traffic, a great amount of time, money and capital has been spent. In early days Reavel's compressor was very much in demand. This compressor is light and compact, but is difficult of access, and as this last is a very necessary qualification, this type has been abandoned in many ships as the main compressor, and the problem was solved by the vertical-compound piston compressor (two stage or three stage).

Auxiliaries.

The most important auxiliaries are the ballast, bilge, sanitary, fresh-water, fire and oil pumps. As these pumps are only in use occasionally, steam for driving them would be an extravagance. It would be out of the question to drive these pumps individually or in groups by small oil engines. The only recourse is to have all auxiliaries driven by electricity, for these are always ready for service at short notice. The auxiliary Diesel motors of two or four cylinders or of two or four cycles have now acquired a high degree of perfection. As these need not be reversible their construction is simplified. The motor plant as a whole has been the subject of much discussion among ship owners, in that the tendency is to have a standardized type, and in a way similar to that of a steam engine. This can hardly be expected. The types now being used are either duplications of the stationary type or the construction has been borrowed from the slow-running steam engine. These motors will perform the same service at sea as they will as stationary engines, notwithstanding the severe usage due to fatiguing and tedious sea-service. The entirely enclosed motor, which without doubt is best suited for stationary service, can not be recommended on account of this severe usage. Easy access to all reciprocating and rotating parts is an absolute necessity in a ship's motor. This does not mean that all protection against oil-squirting has to be omitted, as the experiences of several motor-builders will testify. The ship's motor must be as easily accessible as the steam engine, on account of the special attention its single parts require. The engineer who has to depend on his plant must be able to examine all moving parts without much trouble. The ideal motor is then the one that is enclosed only so much, as to not interfere with the accessibility to its parts.

All pumps intended for cooling, lubricating oil, etc., should be independently driven and not driven from the main motor, as is so often the case today.

In the Motorship "Fionia" these things have been accomplished in a neat way. The maneuvering platform is situated midway between the two motors, and from here the reversing and regulation of the fuel pumps for each cylinder is centralized and operated.

From the start much weight was laid upon the safety of design, and every single member was given a high coefficient of safety, and the result was a heavy ship motor plant.

As mentioned in the first part of this article the weights of the two trial ships "Saltburn" and "Eavestone" were 1,280 tons and 1,260 tons respectively (for the ship and engine). The actual cargo space was 14,280 cub. ft. and 14,000 cub. ft. respectively; a gain of 4½ per cent in favor of the motorship.

For two of the Hamburg-South American line vessels, the Str. "Santa Anna" (6.400 tons) and the M. S. "Monte Penedo" (6,410 tons) the difference is 415 tons in favor of the motorship. It must be taken into account here that the above figure includes the difference between the weight of coal (857 tons) and oil (500 tons).

A point, not to be overlooked, is that the last three years experience gained by motor manufacturers have made it possible to give shipowners a better guarantee and satisfaction in regard to weight and capacity of a motorship compared to a steamer of the same displacement, without sacrificing the novel features and strength of the motor plant.

A motorship of recent date ordered by the Hyland Line for cotton transport, and for which spacious cargo holds are desirable, has on a net tonnage of 41,250 cub. ft. shown a gain in space of 18 per cent over the same size steamer.

The above figures will hold if the main dimensions for each ship give the same cargo-space, and the fuel-consumption is in the ratio of 1-3. A considerable advantage is given the motorship in this case and in every case where light and spacious goods are carried.

To better illustrate these figures some actual facts are printed regarding three ships owned by the East Asiatic Company, of Copenhagen. These are from the first voyages of the S. S. "Kina," the S. S. "Arabien", and the M. S. "Siam."

The S. S. "Kina" and the S. S. 'Arabien" are single-screw vessels with the following dimensions:

Length between perpendiculars	385′ 0″
Beam	53′ 0″
Depth (moulded)	26′ 10¾″
Dead weight	8,720 tons
Bunker (coal)	770 tons

These steamers were built by Swan Wigham & Richardson in 1911 and are equipped with triple-expansion engines. The M. S. "Siam" is a twin-screw vessel, built by Burmeister and Wain in Copenhagen and equipped with their standard four-cycle motors (Diesel). Its dimensions are as follows:

Length between perpendiculars	410′ 0″
Beam	55′ 0″
Depth (moulded)	30′ 0″
Dead weight	9,500 tons
Bunkers (fuel oil)	1,250 tons

All these vessels have made the same voyages under the same conditions so the comparison is very satisfactory, and gives a clear insight of the benefits derived from having a motor power plant installed.

On the voyage of the S. S. "Kina" from Antwerpen to Sabang this ship carried 1,162 tons of coal, thus her cargo was 7,558 tons. On her home-bound voyage she carried 7,788 tons of cargo. The mean cargo for the two voyages was 8,760 tons.

The M. S. "Siam", on her voyage from Antwerpen to Hankow, China, carried 493 tons of fuel oil. Her cargo consisted of 9,007 tons. On the home-bound trip she carried 1,168 tons of fuel, making her have a cargo of 8,332 tons. The mean cargo for the two voyages was 8,760 tons.

From these figures it can be plainly seen that a great advantage is gained by a motor propelled ship.

The engine reports of these two ships may be of some interest:

	S.S."Kina"	M.S."Siam"
Duration of trip, days	163	182
Time engine was in operation, days	109	107.5
Time in harbor, days	54	74.5
Distance in nautical miles	27,808	27.818
Number of hours of uniform propulsion	2,517	2,497
Maneuvering hours	92	82
Mean revolutions (starboard engine)	....	123.7
Mean revolutions (port engine)	....	123.3
Mean for both engines	69.9	123.5
Mean speed per hour in knots	11.0	11.14
No. of hours starboard auxiliary motor running	....	2,127.5
No. of hours port auxiliary engine in operation	....	1,666.5
Fuel consumption per knot in lbs.	384	88.6
Fuel used for firing up boilers, tons	49.6	00.0
Banked fires, tons	31.6	00.0
Full steam up without propulsion, tons	7.8	00.0
Uniform propulsion, tons	4.415	1,061.98
Maneuvering, tons	71.9	14.74
Electric lighting, tons	59.6	19.04
Windlasses and pumps, tons	179.6	23.84
Fuel for main engines, tons	4,576.3	1,076.72
Fuel for auxiliaries and emergencies, tons	282.3	43.48
Percentage (fuel for main engines)	94.2	98.1
Percentage (fuel for aux. and emergencies)	5.8	3.0
Total fuel consumption, tons	4,858.6	1,120.2
Actual No. of tons of cargo	7,673	8,670
Distance covered in knots	27,808	27,818
Total fuel consumption, tons	4,858.6	1,120.2
1,000 tons of cargo is carried 1 knot at a speed of 11 knots with a fuel consumption of, lbs.	50.16	10.23
Saving in cost of fuel for the motorship		67%
A cargo of 8,500 tons would cost in fuel for transportation from Copenhagen to East Asia and return (27,818 knots) at a speed of 11 knots	$28,837	$8,434
Gain for motorship in dollars		$19,403
Percentage of gain for motorship		70%

Personnel of S. S. "Kina"—
3 engineers
2 assistants
14 stokers
Total 19 men

Personnel of M. S. "Siam"—
4 engineers
5 assistants
4 oilers
Total 13 men

For the motorship a saving is made of 6 men or 30 per cent.

The S. S. "Kina" takes coal aboard 10 times during the voyage:

M. S. "Siam" takes on fuel oil twice during the trip, the last time enough is taken aboard so that on the next trip she will only take on oil once.

Second route—Around the world—Europe, South America, west coast of the United States, Japan,

(Continued on Page 16.)

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High Compression Heavy Oil Engine Development Coming

One-Half Pound of Fuel Per Brake Horse Power Hour

The following paper read before the Metropolitan Section of the S. A. E. by Henri G. Chatain of the General Electric Company, analyzes the utilization of heavy fuels in Diesel type engines.

HIGH-COMPRESSION, heavy-oil engines in all probability will come into use for passenger and commercial vehicles and also for airplanes. Present types are not yet suitable for these uses, but there is no really inherent reason why an engine of this kind could not be built and serve satisfactorily.

This is the prophecy made by Henri G. Chatain, of the General Electric Co., at the monthly meeting of the Metropolitan section of the Society of Automotive Engineers in a paper entitled "Treatment of Hydrocarbon Fuels." The paper was essentially an analysis of the manner in which liquid fuels are transformed into energy within the cylinders of an internal combustion engine of the Diesel type.

The production of a Diesel type engine for present land and air vehicle propulsion requires that the basic principles underlying existing types be carried out in proper manner; that a careful study be made of all mechanical parts, and that there be a redesign along rational lines of such devices as now are used for carbureting or breaking up the fuel and rendering it fit to be used in the engine.

Mr. Chatain pointed out that when it becomes thoroughly understood that these motors can be made to operate on less than ½ lb. of fuel per brake horsepower hour and the price of existing fuels continues to increase, a motor of this kind becomes something more than a possibility.

Such Engines in Use in Germany.

In fact, engines of this type already are in use in Germany. In the discussion following the reading of a paper by Philip Lane Scott on the design and construction of the Junkers engine, Scott stated that a Junkers airplane engine has been constructed in Germany and has developed 1 h. p. per 3½ lb. of weight.

Both Scott and Chatain seemed agreed that there are far greater possibilities in the development of a Diesel type or semi-Diesel type of engine for road and air vehicle propulsion than there is in the development of devices for the use of kerosene in present engines, or engines slightly modified to use this fuel.

In response to a question Chatain stated that he had not made any experiments in the use of denatured alcohol for the reason that there had been no wide demand for the use of this fuel. He stated further that, owing to existing laws which require that denatured alcohol remain in bonded warehouses for a considerable time, the small producer is virtually cut off from this market. Until these laws are amended it is entirely too expensive for small producers to turn waste material into alcohol.

In Chatain's opinion, the only logical way to use kerosene is to employ some device that converts the fuel into a fixed gas, rather than into a fog, as is the case at present. With the fog, he stated, it is not possible to obtain that degree of oxidization which is necessary for efficient combustion. A good device would have to operate much like a gas producer.

The kerosene carbureter, which is essentially the same as a gasoline device, he said, is entirely inadequate for the reason that applying heat in the manner it is now applied reduces the efficiency of the engine. It was suggested that a more logical solution of the problem appeared to be the distillation of crude oil at a somewhat higher temperature so as to utilize much of the content which now comes off in the form of commercial kerosene.

Chatain said, in part, as follows:

With the pressing demand of the early days for ever increasing horsepower in automobile engines, necessity made it imperative that some device be produced which would be compact and simple for the purpose of carbureting the air. Even if the volatile hydrocarbons had prevailed, a surface carbureter for a 40 h. p. or 50 h. p. engine would have been prohibitive, due to its bulk alone.

Carbureter Design Complicated.

The jet carbureter was accordingly brought out and had for its basic principle of operation the issuing of one or more small streams of gasoline into a rapidly moving mass of air. The inertia of the jet of gasoline in conjunction with the moving body of air possessed sufficient force so that the liquid was, strictly speaking, mechanically broken up and turned from a liquid to what might be termed a fog.

The design of this apparently simple piece of apparatus is indeed very complicated, so much so that in over 20 years' time with innumerable people of intelligence working upon the problem it is still today, although practical, far from being a comparatively perfect piece of apparatus. It would be well to thoroughly understand the elements which go to compose the gas desired and their proportions and also to explain at some length how these proportions are approximately obtained in the modern jet carbureter.

HENRI G. CHATAIN, ENGINEER

It is well known, for example, that the gas formed by the mixture of air and the fog of gasoline is as highly explosive as possible when it is composed in the environ of fifteen parts of air for one part of gasoline. This is proportioned by weight at atmospheric pressure. Fifteen therefore for the sake of argument may be termed a constant. Above or below this figure the carburetion is not so good. Explosion, it is true, may occur, but the gas becomes poor, and obviously the power of the engine falls off. The disproportionate mixture may be carried to such a point that explosion does not occur at all.

It is also well known that this constant varies with the combustible used. For illustration, as stated above, it is necessary to have fifteen parts of air to one part of gasoline, but it is necessary to have nine parts of air to one part of ethel alcohol, or seven parts of air to one part of methyl alcohol, and so on for the various fuels.

So that the carburetion of the air by the gasoline is always as good as possible, it is necessary that the above-mentioned proportions be kept constant through the range of speed and load and combinations thereof of the motor, it being understood that the changes in speed and in load produce a radical varying effect upon the carbureter as the varying amount of air aspirated decreases or increases the depression or drop in pressure at the gasoline jet. Compensating for this varying depression has never been solved in an entirely satisfactory manner.

Finding a Practical Mixture.

The first question which has confronted the constructor has always been this curious feature of the carbureter. That is, to find a practical mean between gasoline and air at various speeds, loads, and combinations thereof.

The operator then, as well as now, could not be asked to make running adjustments by hand. It was necessary then first to find a means and method to make permanent this constant, and, second, to charge the motor with keeping this permanency of mixture.

It was thought that this ratio of fifteen to one would necessarily stay constant, even with the variations in the functioning of the motor, and the relative value of the depression caused by the aspiration of the motor would remain constant with relation to the gasoline and keep the proper proportions, the orifices admitting the air and gasoline to remain fixed.

This assumption was an error. Air is a gas. Gasoline is a liquid. The masses of the two bodies are therefore not equal, and therefore the inertia is unequal. As the liquid is put in motion, caused by the depression in the intake pipe, it has an inertia greater than that of air, and the liquid therefore continues to come out of the orifices a moment or two after the load has been thrown off or the speed of the motor reduced, while, on the contrary, the air issuing through the orifices in the vicinity of the gasoline jet ceases instantly or nearly so, upon the reduction of speed or load of the motor.

The permanency of the constant would exist without any special apparatus if we were dealing with two gases, for instance air and illuminating gas or natural gas. The mixture of the two gases would have an inertia quite the same, it would come out of the respective orifices in a fixed proportion, once they were adjusted for various speeds and loads of the motor.

The conclusion was arrived at therefore that with this type of carbureter some form of device would have to be utilized to admit more or less air and thereby increase or decrease the depression in the intake pipe so as to keep the constant in proper proportion. Hand regulation of the above-mentioned device was at first resorted to, but, as I have already stated, this was found to be impracticable, as one never knew exactly when the carbureter was adjusted so as to maintain the proper proportions of fifteen to one, with the net result that at times the motor ran properly, but more often it did not.

To the early French investigators must be given the credit for having developed the prototype of the modern carbureter, a device which is well known today, making itself manifest in various and diverse arrangements in the way of auxiliary valves to admit air, auxiliary nozzles to admit gasoline, automatic and hand chokes placed in diverse positions.

Still Far from Perfection.

Experience gained through 20 years of carbureter building has brought this piece of apparatus up to a point which can be considered standard, but still a considerable distance away from being perfected for the following reasons:

It does not produce what might be termed a gas.

Forces utilized in its functioning are insufficiently powerful to utilize a fuel other than the comparatively volatile combustibles.

It is the contention of the writer that, broadly speaking, it is necessary to decrease to a minimum the so-called viscosity of the combustible before the best results can be obtained in a given cylinder. This statement it is appreciated is somewhat ambiguous. It is conceded, but it is believed that a further dissertation on the breaking up of combustibles will suffice to make the writer's contention clear.

As most lines of endeavor and effort are conducted along the path of least resistance, it is noteworthy and curious to understand just why the principal effort outside of the utilization of the very volatile hydrocarbons, such as gasoline, has been made along the lines of utilizing heavy hydrocarbons, such as fuel oil, various crude petroleums, tar oils, etc., etc., rather than a concerted and well defined effort to utilize what is commercially known as kerosene.

It is probably due to the fact that the market price of gasoline has been, up to the present year or so, comparatively so low as to discourage endeavor in the field just suggested.

Surely conditions are changing and will change so as to make it imperative that the next combustible along the path of least resistance, namely kerosene, will be utilized.

This brings us to a consideration of what has

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actually been accomplished in the utilization of kerosene.

Utilization of Kerosene.

The demands to solve this problem have resulted in certain distinct types of devices, which are as follows:

1—The commonly accepted type of gasoline jet carbureter with heat applied in various ways:

(a) To the fuel itself.
(b) To the air.
(c) Heated jacket.
(d) Heated jacket plus heated intake pipe.

2—Devices which will partly burn the fuel before it is admitted to the intake pipe, forming a more or less fixed gas intermingling to a greater or less extent with the vapor of the combustible.

3—Devices which admit the combustible in the cylinder direct, the valves of the motor being so regulated as to cause a partial vacuum in the cylinder prior to the admission of the combustible.

4—Where the combustible is impinged by means of a pump, or otherwise, directly upon a hot surface in the interior of the cylinder, or a chamber adjacent thereto.

5—Devices which raise the temperature of the combustible to the boiling point producing vapor but in no sense of the word a fixed gas.

Criticisms of Present Methods.

1—To criticize the endeavors formulative of the first group is a comparatively simple matter. The investigators obviously took the existing device and have tried to apply it to a fuel which is in many respects distinctly different from gasoline or the fuel for which the device was designed and intended. Primarily the forces manifest in the gasoline carbureter are absolutely insufficient to turn kerosene into a fog, or rather put it in a condition such that it would commingle with the oxygen in the cylinder and be readily inflammable.

Secondly, the complication of heat is essentially the same as applying another force to destroy the viscosity of the combustible, and when this has been judiciously applied certain results have been obtained which are for certain purposes at least encouraging, but so far impracticable when the motor is to be considered as applicable to an automobile or kindred service. The troubles are many. The source of supply of the heat is inconstant. It is difficult to regulate it. Its action lags, that is to say, when a sudden demand is made upon the motor for increased combustible, the heat requisite is not available until the combustible is actually burnt, and it is perfectly obvious that sudden variations in load and speed cannot be well taken care of by this process.

In starting the motor it is necessary to derive heat from an exterior source. This is inconvenient and irksome.

For stationary engines, certain classes of boats or other applications, where a skilled attendant is available, this type of gas-making device has had and is having success. Again it would appear that this type of device presents insufficient force to accomplish the results desired.

2—The second type, or what might briefly be called the fixed gas type, presents many attractive features. In starting all that is necessary is to ignite, by means of a wick, part of the combustible, no other preheating being necessary. With proper regulation of the amount of fuel actually set afire and relying upon the aspiration of the motor, a reasonably permanent gas can be formed and regulated under the adverse conditions under which we are working. The power to destroy the viscosity of the oil is plainly evident. It is set afire and permitted to burn. No preheating devices are necessary.

The writer has actually operated a device of this character in extremely cold weather with gratifying results. We certainly may look forward to future developments. It would be well to bear in mind, however, that the efficiency of the motor will probably be decreased with this type of device, as the gas produced under the circumstances is such that moderately low compression is desired.

3—An engine utilizing this principle was devised in France some few years ago, and, although it did not meet with immediate success, the principle involved was novel and attractive.

It is not a foregone conclusion that the forces obtaining in the ordinary intake pipe, comparable with a depression of a certain pressure per square inch would have the same result in breaking up the fuel as a corresponding and similar vacuum produced in the cylinder proper, fuel being admitted therein directly.

A device was experimented with to some extent by the writer, and although it was possible to start an engine cold, the cycle of events occurring in the cylinder was so divergent from normal, due to the very late opening of the intake valve, that the experiments were discarded, and no great amount of work done along these lines, also for the reason that the scheme introduced what appeared to be excessive complication.

4—This method of utilization of combustible is well known. It is not necessary to discuss it at great length here, as it has the insurmountable fault that it is necessary to preheat the engine, and this it would appear can only be done in a practical manner by means of some form of blow torch, requiring several minutes to heat the parts sufficiently so as to make starting certain. If a multi-cylinder engine, such as the prevailing types of the day, were used, the complication and trouble would make the scheme highly undesirable.

5—About the same criticism can be made for this scheme as for No. 4. It is hardly worthy of further investigation for our purpose. The idea has about all of the attendant disadvantages of the steam boiler with a few added.

Use of Heavy Hydrocarbons.

In passing from the utilization of kerosene, the next logical step is to the very heavy hydrocarbons, and although there is still a great deal to be accomplished in this field, much has already been done.

For comparatively large powers and for diverse purposes, the high compression oil engines—I refer now to engines whose compression goes to 500 lb. per square inch or thereabouts—is an accomplished fact, hundreds of thousands of horsepower being in daily use throughout the world. A brief description of its principle, but only a brief description is in order.

The four-stroke cycle and two-stroke cycle are used, and have their advocates, who claim their respective superiorities. Pure air is taken or admitted to the interior of the cylinder. This is compressed to 500 lb. to the square inch or thereabouts and at a point approximating the upper dead center of the piston or slightly before, fuel is injected in the form of a fog or fine spray and upon coming in contact or commingling with the highly heated air in the interior of the cylinder, inflammation results. This obviously increases the temperature of the air, which in turn is expanded.

Up to the present time the accepted form is the air injector. The function of the injector is to receive a definite quantity of combustible, this per cycle, and usually propelled to the injector by means of some form of pump.

It is quite immaterial at what portion of the working cycle of the engine this oil is delivered to the injector, suffice that it go there in proper quantity and in synchronism with the rotative speed. Its quantity is a function of the load on the engine. To this same injector device, air is led from a pump or suitable container under pressure varying in practice usually from 800 lb. to 1300 lb. per square inch.

The injector is also equipped with a cam or otherwise actuated needle valve. This needle valve being opened on or slightly before the upper dead center of the piston, permits the contents of the injector to come out in the form of fog or fine spray. There is still another small portion of the injector, but still of great importance, and this is known as the flame plate. Its function is to divert in the proper direction the incoming spray or fog from the injector. This is usually accomplished by one or several small holes of suitable size pointing in the proper direction.

Distribution Must Be Uniform.

This, pointing in the proper direction, brings up a very important point in regard to utilizing combustible in this manner. It is obviously essential that the entire combustion chamber should be filled simultaneously or as near so as possible with the combustible.

If the flame plate was so arranged so as to distribute the combustible in only one-half of the

Solid Injection for Diesel Engines

Some Details of the Vickers' System Over Which Secrecy Is Maintained

As several times mentioned in these columns, Vickers Ltd., of Barrow, the British submarine builders, have been using solid, or pump, injection of fuel with their four-cycle type submarine Diesel engines, which, of course, has the advantage of enabling them to dispense with high-pressure injection-air; but, with the disadvantage of giving a higher fuel-consumption, which amounts to as high as 10% compares with good air injection systems.

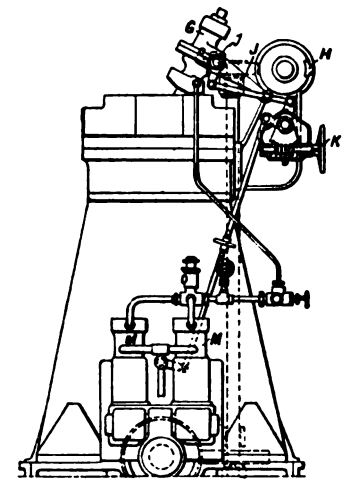
Under the guidance of Vickers' technical-director, Mr. J. McKechnie, considerable improvements with solid fuel-injection are constantly being made and we understand that it now is used with reasonable success, even in connection with the largest submarine engines, which are said to develop about 1,500 to 1,600 b. h. p. from twelve cylinders at 350 r. p. m., or over 3,000 b. h. p. per boat. Great secrecy always has been maintained by Vickers, and no illustration of any of their submarine-Diesel-type engines ever has been published or technically described, and in this they are entirely alone.

However, the patent office is a very useful source of information for engineering-journalists, so that Motorship thus is enabled to give some information regarding their latest improvements in solid-injection for Diesel-type oil engines.

According to the most recent patented invention of Vickers, the fuel is delivered by a pump M giving constant fuel pressure (by the aid. for example, of an adjustable relieve valve) and the power of the engine is controlled by varying the period of opening of the injection valve G by an adjustable lever J operated by a cam H, the shape of which is so related to the path given to the end of the lever by the adjustment that for all adjustments and consequent variations in engine power the valve is timed to open at the correct point at which injection should take place. Independent timing means are therefore dispensed with, the cam being formed to give proper timing for the operation of the valve for all variations in the period of opening.

In the construction preferred the control of the injection valve G is effected by a valve lever J' on an eccentrically mounted pivot J which varies the clearance between the lever and the cam H and at the same time displaces the cam roller over the circumference of the cam in the desired direction to produce, with the cam, the proper timing of the valve opening in conjunction with the variation in the duration of the opening which determines the power of the engine. The adjustment of the valve-lever cam H is preferably effected by lever and link connections to a control wheel K, which may act through a worm and worm segment. Connections may also pass from the same control to the suction of the fuel pump or pumps M, so that the output of the pump is simultaneously regulated, for example, by varying the closing of the suction valve.

The pump is of a larger capacity than is required by the engine, and surplus fuel is discharged through the adjustable relief valve, which is set to give the injection pressure. The control of the suction of the pump allows, however, the output of the pump to be regulated as the power of the engine is varied.



DETAILS OF THE VICKERS' METHOD OF SOLID INJECTION OF OIL FUEL WITH DIESEL ENGINES

Excess fuel is always delivered by the pump, so that the pressure to which the relief valve is adjusted is maintained, but the excess over that required by the engine is kept approximately constant, thus assisting the relief valve to maintain a steady pressure. This connection to the fuel pump is particularly desirable for constant speed engines, for example, those driving dynamos in which the surplus to be passed by the relief valve would otherwise be greatly increased while running at light loads.

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cylinder, the power and output of the engine would go down to an appreciable extent.

In this respect I wish to clearly point out that the high compression engine is distinctly different from the engines utilizing fuel which has been admitted prior to the compression stroke. In this instance the compression stroke serves to a great extent to thoroughly mix the combustible with the air and presents a homogeneous mass at the time the inflammation is started.

The development of the art is such that with the injector, as described above, and commonly used, it is possible to operate an engine at rotative speeds as high as 550 r. p. m. or thereabouts. Although fulfilling the writer's theory in regard to great power to destroy the viscosity of the oil, the accepted type of injector today operating a 1000-lb. pressure per square inch is still incapable of furnishing the necessary force to operate properly at speeds higher than stated above.

The time necessary for the oil and air to go through the circuitous passages of the holes of the flame plate, all of which are apparently essential in the breaking up of the fuel, is excessive when we contemplate utilizing this device for high rotative speeds or in engines for automotive purposes.

It is essential in the design of an injector to so construct it that oil will make its way to the combustion chamber in advance of the injection air. The reason for this will be better understood when one considers that the injection air is expanded from 1000 lb. per square inch down to 500 lb. with attendant refrigerating effect, which tends to decrease the temperature of the immediate surrounding air and render combustion slower and less positive.

A number of attempts have been made to discard the injection air and resort to solid injection. Nothing of this character has ever been attempted in this country, at least so I believe. An English firm of note, however, has apparently carried this line of investigation to a point where it is at least workable. Although from reports upon the subject it would appear that the economy of their engines is lower than is customary and that they experience a smoky exhaust with attendant difficulties which result from imperfect combustion.

The Open Nozzle Injector.

There is another device known as the open nozzle injector. Its operation is as follows: Into a small declivity or pocket in the cylinder the fuel is pumped in the requisite amount. Impinging upon this oil is air of 1000 lb. pressure per square inch, the needle valve of which is opened at the proper time on the stroke.

This causes the fuel to be broken up and violently thrown around the combustion chamber.

This scheme has at least one great advantage, that no oil passes through the needle valve, and therefore it is not susceptible to clogging.

There is one very important feature in regard to internal combustion engines of the high compression type which apparently so far has not been given a great deal of thought, and that is that with the most approved type of injector and all in excellent operative condition it is still necessary to have some 40 per cent to 50 per cent of excess air in the cylinder to produce perfect combustion. If the engine is overloaded, smoky exhaust is produced, meaning that the inflammation is not completed during the working stroke. Obviously this is a waste of fuel, not to mention the detrimental effects produced upon the mechanical parts of the engine.

This is indeed a most important point, as it is quite obvious that if a greater percentage of the air which is taken in per cycle could be carburetted and utilized, the size of the engine could be diminished.

It has long been the belief of the writer that a big step in advance is due and is coming when other means will be found and devised for subdividing the incoming fuel into finer particles than is done at present, permitting each tiny particle to become thoroughly oxygenated in the shortest possible time.

It is possible that an entirely different shaped combustion chamber from the existing types should be used; that is, a combustion chamber which will be constructed in a shape to conform with the jet of incoming fuel.

The writer has been asked the question many times, if it would not be possible to apply the existing principles of the high compression oil engines to motors which would be suitable for automobiles and kindred purposes.

Existing Engines Not Suitable.

Invariably the question has been answered that the existing types so far are not applicable, but it must be frankly admitted that there is no really inherent reason why a motor could not be built which would apply. It means carrying out in a proper manner the basic principles underlying the existing types, but it also means a careful study of all the mechanical parts, and a redesign along rational lines of the device now used for carbureting or breaking up the fuel and rendering it fit to be used in the motor.

When it becomes thoroughly understood that these motors can be made to operate for less than ½ lb. of fuel per brake horsepower per hour and the price of existing fuels becomes higher, the proposed idea will come about and become a reality.

Some form of two-stroke engine would adapt itself better for this class of service than the four-stroke cycle. The reason for this is that in the two-stroke cycle engine of this category the compression pressures used of 500 lb. per sq. in. and over would be sufficient to counteract the inertia of the reciprocating parts with the result that the pressures on the piston pins and crank pins will always be downward or in the same direction.

As this will be the case, the trouble of taking up bearings for quiet operation would be done away with. The same could be permitted to wear to a considerable extent before requiring attention. The fact that this pressure would always be in the same direction introduces a problem in lubrication, but this can and has been successfully overcome.

It would appear that it would be advisable to experiment and investigate along the lines of solid injection, utilizing extremely high pressure, possibly as high as 6000 lb. or 7000 lb. to the square inch rather than go to the complication of utilizing air for this purpose, with its attendant multiple-stage compressor and paraphernalia.

Preparation of Fuel.

The writer knows of no effort that has been made of especially preparing fuel prior to its use in the motor. It is barely possible that experiments conducted along these lines might materially assist in solving the problem.

The greater amount of surface that can be presented by the broken-up fuel, the better. This apparently means that each tiny particle should be a sphere. Secondly, it means that each tiny particle should be a hollow sphere, and the thinner the wall the better. Exactly how to do this commercially is still in the realm of the unknown.

The fuel question is unquestionably a serious one at the present time, but it is the writer's belief that it is but temporary. The path of least resistance will undoubtedly be the application and utilization of kerosene, not as attempted through the utilization of existing types of carbureters, but with a device distinctly constructed and embodying the requisites for the purpose.

When such a device is brought about, it will permit the utilization of enormous quantities of this class of petroleum to be used, which is now more or less of a drug on the market.

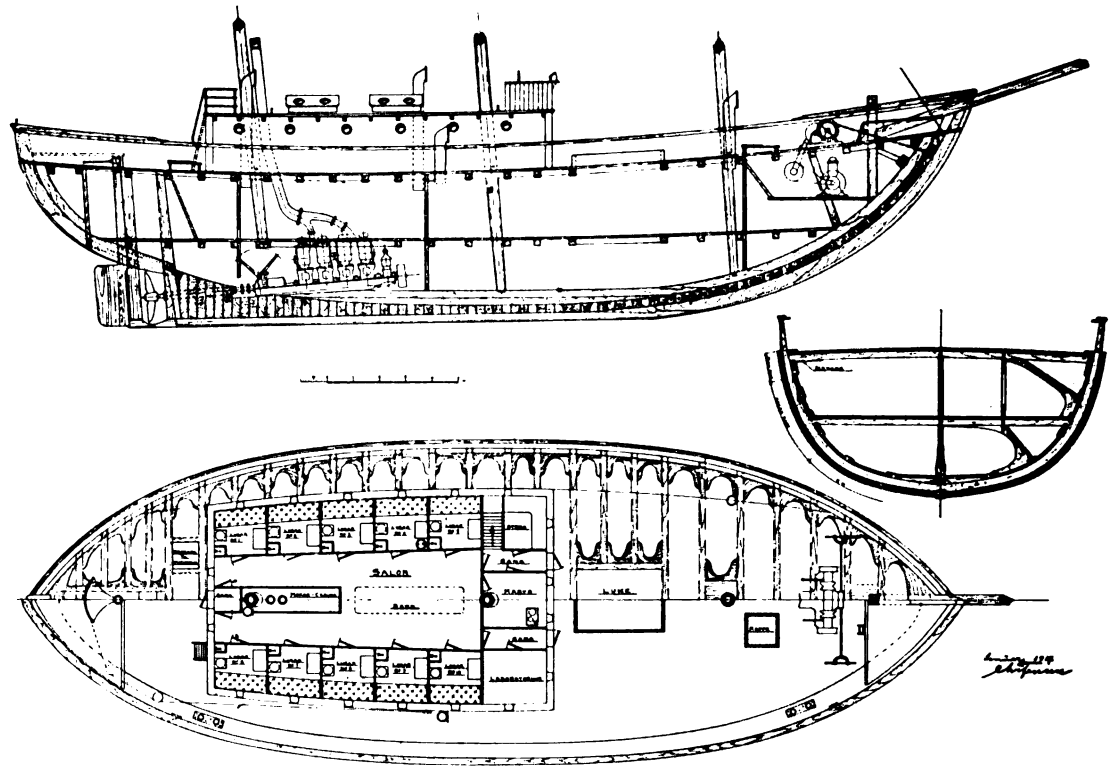
The next step, and especially for commercial purposes, will be the utilization of the heavier category of petroleum and such other oils as tar oil and oils from the lignites, deposits of which in the great Northwest are almost limitless.

The following qualifications are desirable:

First.—The particles of oil should enter the cylinder prior to an injection of air.

Secondly.—That the breaking up of the fuel is better accomplished if the oil meets the injection air in some portion of the injector at right angles. A circuitous passage is obviously desirable, but its resistance should not be too great in cases where a great number of injections are required per minute, as this delays the delivery of the fuel to the heated air contained in the cylinder, and also delays the total inflammation of the mass.

Polar Expedition Motorship "Maud"



DR. AMUNDSEN'S new auxiliary motorship "Maud" has been completed at the Chris Jensen Shipyard, Asker, Norway. She is a staunch vessel built to withstand almost any condition that may arise. She is 120 feet long, has a beam of 40 feet and is constructed for the most part of hardwood. The keel which is in two lengths is made of oak 14"x13½". The stem (20"x13"), deck and all other beams, knees and stanchions, and planking (4¾"x4¾") are all made of oak. The decks are of the very best seasoned fir 5"x3½". The outside covering of the hull is made of the highest grade of Greenheart, 2¾" thick. All parts are bolted together with galvanized bolts and spikes, and wooden plugs. The inside skin of the vessel is of 4" fir. This is also fastened together with galvanized bolts. She has a capacity for 100 tons of fuel oil and is equipped with two 240 b. h. p. Bolinder oil engines.

Officers and crew are together in a house on the deck aft of the center mast. The steering arrangement and control is in a house above this cabin, forward. This vessel has a unique feature to guard against any trouble with the propeller and rudder while the ship is in the ice fields. The rudder and propeller can be drawn up into a well-like arrangement and the hole closed to keep out the water. This device is clearly seen from the accompanying illustrations.

The "Maud" is of the fore and aft schooner type. Four standing gaffs are fitted so that the sail instead of being taken down can be drawn to the masts.

She is very broad above the water line and practically circular at the keel. This enables the vessel to rise when ice begins to form about it.

Three tons of oakum were used in the calking of the vessel which was calked eight times before she was placed in the water.

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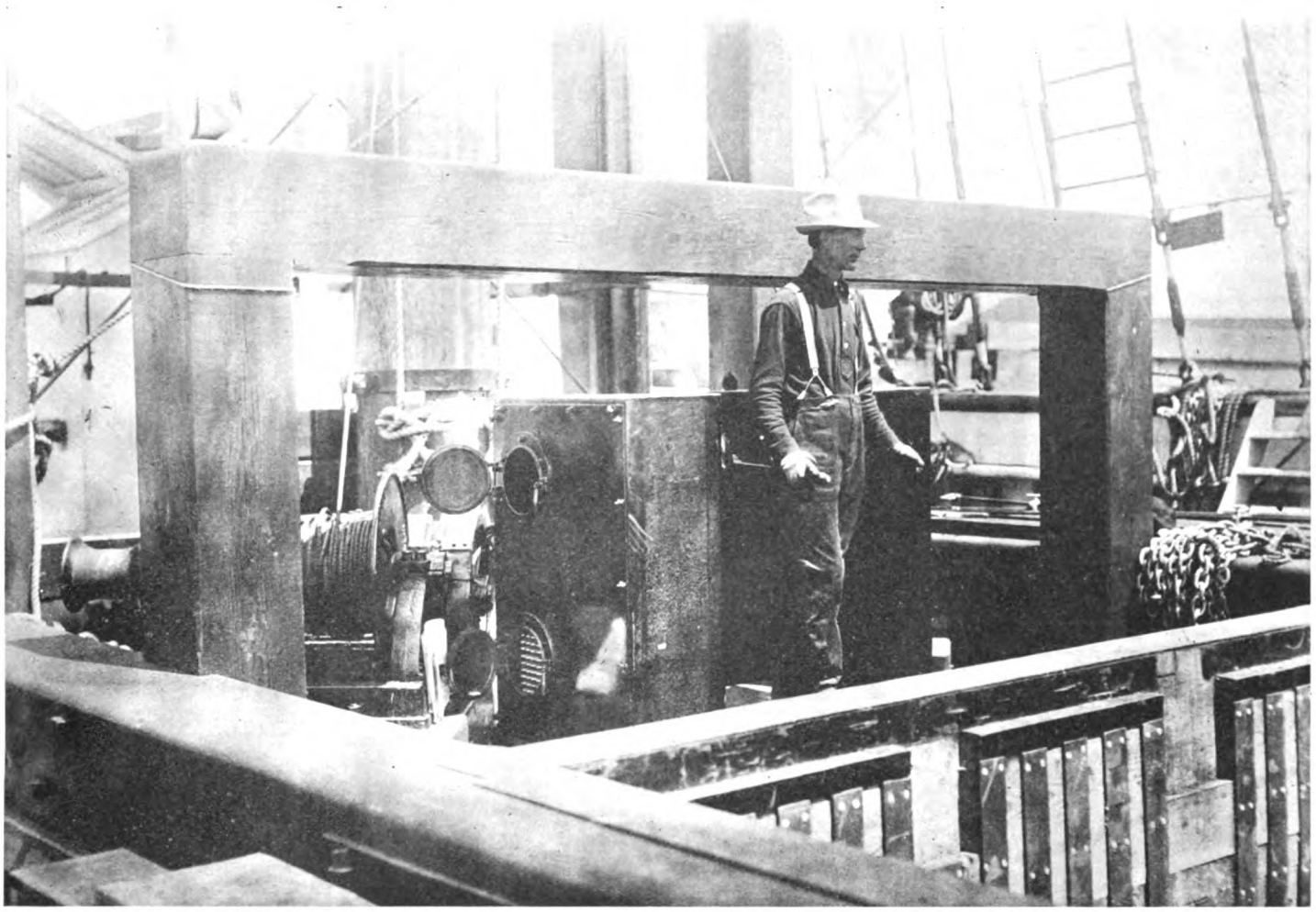
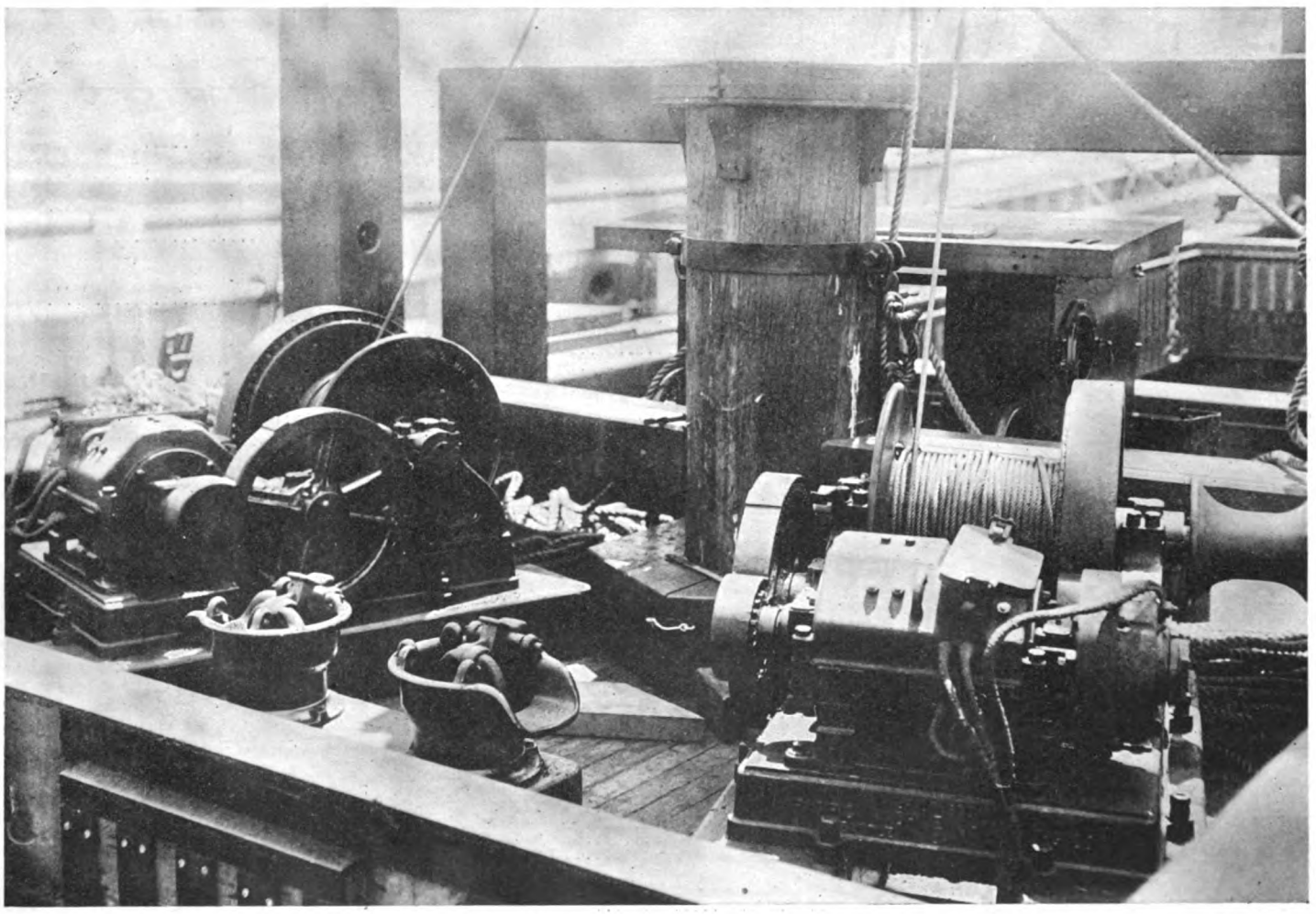
Deck Machinery of Motor Auxiliary "Margaret"



ELECTRIC WINCH CONTROLS—NOTE SIMILARITY TO STEAM EQUIPMENT (ANY MAN USED TO STEAM GEAR CAN HANDLE WITHOUT SPECIAL TRAINING). THE WATER-TIGHT PORTS ARE SEEN OPEN FOR VENTILATION WHILE RUNNING.



TWO 2-TON ELECTRIC WINCHES, SPEED 125 FEET PER SECOND, MANUFACTURED BY THE PACIFIC MACHINE SHOP & MANUFACTURING COMPANY, OF SEATTLE, WASH., DRIVEN BY GENERAL ELECTRIC COMPANY MOTORS WHICH ARE TOTALLY WATERTIGHT. ON THE EXTREME RIGHT OF RIGHT HAND WINCH IS THE HOLDER BRAKE (AUTOMATIC IN CASE POWER IS SHUT OFF).

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Some American-Built Bolinder-Engined Ships

DURING the past three years one European marine oil-engine company has met with an extraordinary reception in the United States, and it is of little use to try to blind our eyes to the fact that, despite being hampered by a 20 per cent customs importation duty, and unusually heavy freight and insurance charges, they have been able to obtain in excess of five million dollars ($5,000,000) worth of business from American and Canadian shipowners. It was not "price cutting" that has enabled them to obtain this business; because their prices consistantly have been higher than those of most domestic manufacturers. Evidently it was due to their own foresight in realizing that the market could be made for marine oil-engines, and in having a really good product backed by the organization and productive ability to promptly meet the demand when it suddenly came. Also the lack of cooperation and standardization among such domestic manufacturers as then did exist assisted them to a considerable extent.

For six months after the Bolinders Co. of Stockholm first entered the market they did not sell a single engine. Suddenly domestic shipowners realized what a good oil-engined vessel meant to their business, and then came the war-demand for ships, with the result that the Bolinders Co. were overwhelmed with orders. This naturally created a huge demand for domestic marine oil-engines of this type which also has benefited many American manufacturers, and they too became busier than any previous time in their history, and now nearly every marine oil-engine builder in the United States is overcrowded with orders for a year, or more, ahead, the demand far exceeding the supply.

Numerically, the majority of Bolinder engines have been installed in wooden auxiliary ships, but one steel full-powered vessel has 1,500 b. h. p., and three other steel sister ships have 1,000 b. h. p. each.

As is well-known a very large number of the wooden auxiliaries have been built on the Pacific Coast. One of these is the "Astri," which ran her trial trip on July 11th, attaining a speed of 9 knots. This vessel, a four-masted schooner, was built at Portland, Ore., for A. O. Anderson & Co., of New York. She is 266 ft. long by 43 ft. breadth, with 21 ft. moulded depth, and has a dead-weight-capacity of 2,600 tons. Her auxiliary power plant consists of two Bolinder motors, aggregating 640 b. h. p.

About a year ago the Texas company of New York converted the old ship "Maryland" to auxiliary motor-power, by the installation of two Bolinder engines, which together developed 640 b. h. p. The "Maryland" is of 6,800 tons d. w. c., and has a length of 210 ft. with 42 ft. breadth of beam and 15 ft. moulded depth.

The M. S. "Allard," "City of Portland" and "City of St. Helens" were dealt with in our last issue, so need no description now. All three of these McCormick owned auxiliaries are driven by Bolinders motors.

Messrs. W. & S. Job & Co. have been responsible for the building of a large number of auxiliaries, and for the fitting of oil engines into existing ships, and throughout they have remained steadfast to the Bolinders engine. The "Percy R. Pyne," which was built in Camden, Maine, a vessel of 2,200 tons d. w. c., was equipped by them with Bolinders engines, and then sold to Mr. Percy R. Pyne. They also installed oil-engines in the "Madeline Constance," which installation has just been carried out. One of their present auxiliaries is the M. S. "Alembic," a steel-built vessel carrying oil in bulk, having a capacity of 2,000 barrels. This sailing ship is 122 ft. 5 ins. long by 24 ft. 1 in. breadth, with 15 ft. 1 in. moulded depth, and is equipped as auxiliary power with a Bolinders engine of 140 b. h. p. Two other vessels which they installed with auxiliary power, but not American boats, are the "Netherton" and the "Earlshaw."

Another New York firm that has adopted the oil engine is J. B. King & Co., and they have put a number of Bolinders motors into big barges, including the "Daniel M. Munroe," which we illustrate.

Another Bolinders-engined vessel that was recently sunk by the Germans is the "Carmela," an auxiliary motor bark, owned at Mobile, Alabama. She was an iron vessel of 2,200 tons dead-weight-capacity, 262 ft. long, 37 ft. 6 ins. breadth, and 22 ft. loaded draft. Her speed under power is seven knots, and this was expected to be increased as soon as more efficient propellers were fitted. The propelling machinery was two Bolinders 160 horse-power heavy oil engines driving twin-screws, which engines were installed in the extreme stern and therefore occupied very little room, and have been very successful and economical. The owner stated that all of his expectations had been realized and that he was entirely satisfied with the result. There were also two auxiliary single cylinder 25 horsepower kerosene oil engines which were used for pumping, hoisting sails, etc. The engine room staff consisted of two engineers and an oiler.

Another big order that the Bolinders Co. secured was for six steel-built four-masted bald-headed schooners of 3,300 tons dead-weight-capacity. In each of these vessels was installed a 320 horsepower engine, placed aft. When these vessels were nearing completion on the Great Lakes they were purchased by the Standard Oil Company, and are known as the Starlite class, they being named the "Daylight," "Dawnlite," "Moonlite," etc. They were designed by Cox & Stevens of New York, and have an over all length of 261 ft. with 43 ft. 6 ins. moulded beam, 23 ft. 6 ins. moulded depth, and have a speed of 7 knots under power, without the use of sails, on a loaded draft of 18 ft. 6 ins. These ships are designed to carry bulk cargo, and are fitted with three center line hatches 16 ft. by 24 ft., each hatch having a separate winch and cargo boom, which are supplied by steam from donkey boiler.

Though an American boat the motor-auxiliary "Cupica ex Elfleda," is applicable to this article, as she is owned by Messrs. Crew Lewick & Co., of Philadelphia, and is trading between Philadelphia and Hague. The power plant of this vessel consists of two 120 b. h. p. Bolinders motors. Her dimensions are 226 ft. length by 36 ft. breadth, and 23 ft. moulded depth, while she carries 1900 tons dead-weight-capacity. The illustration of this vessel shows her in Philadelphia Harbor preparatory to taking on board a load of cargo. She is a steel-built vessel.

Another interesting little vessel is the 3-masted auxiliary schooner "Gilbert Island."

Even in Bolivia the marine oil-engine has been appreciated, and now navigated on Lake Titicaca is the steel motor-driven cargo-ship "Yavori," owned by the Southern Railway of Peru. This vessel is 146 ft. long by 17 ft. breadth and 7 ft. draft, and is of 260 tons dead-weight-capacity. She is driven by one 320 b. h. p. Bolinders engine.

We must not omit to mention the wooden motorship "Ocmulgee," owned by the Macon Atlantic Navigation Co. of Macon, Ga., which is installed with a two-cylinder Bolinders engine.

These vessels by no means deal with all the Bolinders-engined ships in America; but give a comprehensive idea of the enormous amount of business that this well-known Swedish company has managed to secure.

FULL-POWERED MOTORSHIPS.

(Continued from Page 10)

China, Vladivostok and thence to Europe via Suez Canal.

S. S. "Arabien," fifth trip, March 21, 1913, to January 15, 1914.

Belfast (coal bunkers), tons	86			
Barry, tons	26.75	Rec. 1,298	—Total,	1,324.75
Antwerpen, tons	1,235.5	Rec. 320	—Total,	1,555.5
Teneriffa, tons	1,181.5	Rec. 545	—Total,	1,726.5
Caranal, tons	686	Rec. 590	—Total,	1,276.0
San Francisco				
Seattle (bunkers), tons	388	Rec. 205.2	—Total,	593.0
Vancouver				
Portland	211.25	Rec. 750	—Total,	961.25
Karatsu				
Shanghai, tons	253.75			
Karatsu, tons		Rec. 1,950		
Kuschiro, tons	1,923.5			
Portland, tons	1,227.25	(unld. 142)	—Total,	1,085.25
Karatsu, tons	84.45	Rec. 190	—Total,	274.75
Shanghai, tons	180.25			
Karatsu, tons		Rec. 1,600		
Vladivostok, tons	1,527.25			
Singapore, tons	932.5	Rec. 188	—Total,	1,085.25
Suez				
Port Said, tons	205	Rec. 660	—Total,	865
Aarhus				
Stettin, tons	28.5	Rec. 350	—Total,	378.5
Copenhagen, tons	303.5			
Outgoing cargo, tons	8,720	—1,555	=7,165	
Cargo U. S. to Japan, tons	8,720	—1,085	=7,635	
Homebound cargo, tons	8,720	—1,120	=7,600	
Mean cargo capacity for the whole trip, tons				7,500

M. S. "Siam," second trip, Oct. 14, 1913, to May 27, 1914.

Copenhagen, fuel oil, tons	820.9			
Aalburg				
Rotterdam, fuel oil, tons	780.4			
Antofagasta				
San Pedro, fuel oil, tons	207.4	Rec. 975	—Total,	1,182.4
San Francisco, fuel tons	1,161.5	(unld. 991.7)		
Vancouver, fuel oil, tons		Rec. 935.8	—Total,	1,105.6
Seattle				
Tacoma, fuel cargo, tons				1,056
Kobe				
Koji				
Dalny				
Vladivostok				
Shanghai				
Singapore				
Pulo Bokum, fuel oil, tons	639.5	Rec. 575.8	—Total,	1,215.3
Port Said				
Dunkirk				
Antwerpen				
Copenhagen, balance in tanks, tons				869.8
Out-going cargo, tons	9,500	— 780	=8,720	
Cargo between west coast U. S. A. and Japan, tons	9,500	—1,056	=8,440	
Homebound cargo, tons	9,500	—1,215	=8,285	
Mean cargo for the whole trip, tons				8,500

Engine Log and Reports.

	S. S. "Arabien"	M. S. "Siam"
Duration of trip (days)	300	236
Time engines in operation		
Time in harbor	117	96
Distance travelled in knots	45,676	34,819
No. of hours uniform propulsion	4,278	3,279
No. of hours maneuvering	109	68
Mean r. p. m. starboard engine		121.84
Mean r. p. m. port engine		121.66
Mean r. p. m.	67.0	121.75
Average speed per hour (knots)	10.7	10.6
No. of hours starboard aux. engine running		2,665
No. of hours port aux. engine running		2,539
Fuel consumption (lbs. per knot)	410	91.3
Lubricating oil consumption per i. h. p. (lbs.)		.00195
Fuel used for firing up boilers, tons	66	0.00
Fuel for banked fires, tons	77.5	0.00
Full steam up without propulsion, tons	16.95	0.00
Uniform propulsion, tons	7,600.75	1,357.9
Maneuvering, tons	102.5	18.3
Electric light, tons	149.75	23.4
Heating plant, tons	49.25	27.5
Windlasses and pumps, tons	396.25	18.9
Fuel for main engines, tons	7,863.7 (or 92.1%)	1,376.2 (or 95.2%)
Fuel for auxiliaries and emergencies, tons	670 (or 7.9%)	69.8 (or 4.8%)
Total fuel consumption, tons	8,533.7	1,446

Comparison of the two ships on the trip around the world:

	S. S. "Arabien"	M. S. "Siam"
Actual cargo (tons)	7,500	8,500
Distance covered in knots	45,676	34,819
Total No. of tons of fuel	8,533.7	1,446
1,000 tons of cargo carried 1 knot at a speed of 10.6 knots, costs (cents)	13.4	4.18
Saving in cost of fuel in favor of the motorship		67%
An actual cargo of 8,500 tons will cost (in fuel) to be transported around the globe (35,000 knots) with a speed of 10.6 knots	$39,825	$12,489
Gain in dollars in favor of the motorship		$27,336 (or 68%)

The S. S. "Arabien," outbound, took on fuel 14 times during the trip, while the M. S. "Siam" took on fuel 3 times, and of these one time was due to fault in delivery. At the end of the voyage the amount of fuel remaining was sufficient to carry her to the first fuel oil base.

The saving of 68 per cent of the cost of fuel is the most evident result in favor of the full-powered marine Diesel. In this is included the consumption of power for loading and unloading, the light, heating, etc. The larger cargo space and the saving in the personnel of the crew is not taken into account. The longer the voyage, the more economical motorships are. Routes should be picked where only one stop for taking on fuel would be necessary for the round trip.

These figures have been given to give owners a clear and truthful insight into today's motorship situation and making clear the points of interest. Many have over-taxed the problem, thereby causing suspicion amongst owners, and a great amount of confidence is lost.

Hardly any ship company in the world is more proud of their motorships than the East Asiatic Company of Copenhagen, and the supremacy of their motors is due in a large measure to the cooperation of the Burmeister and Wain Company, who built their motors and a great number of the ships.

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* This is the conclusion of the article on Full Powered Motorships by Mr. Morton, the first installment of which appeared in the June issue of Motorship.

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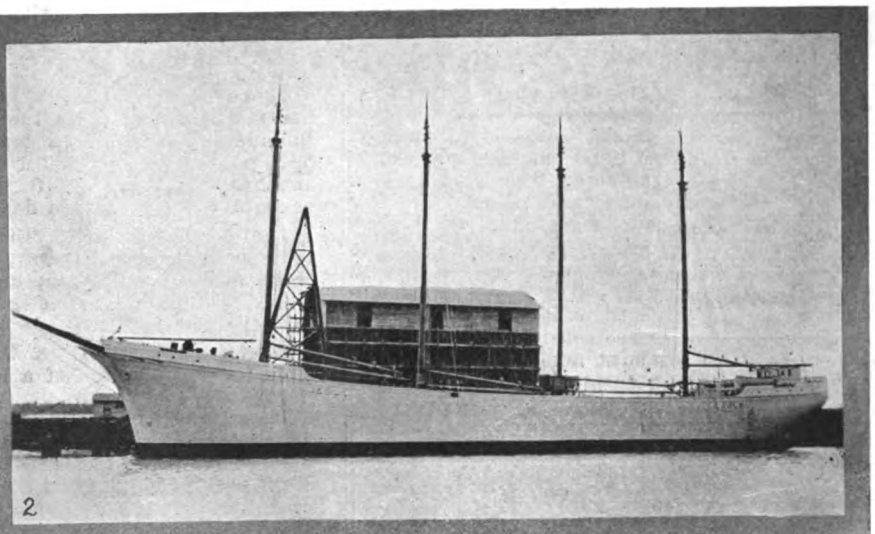

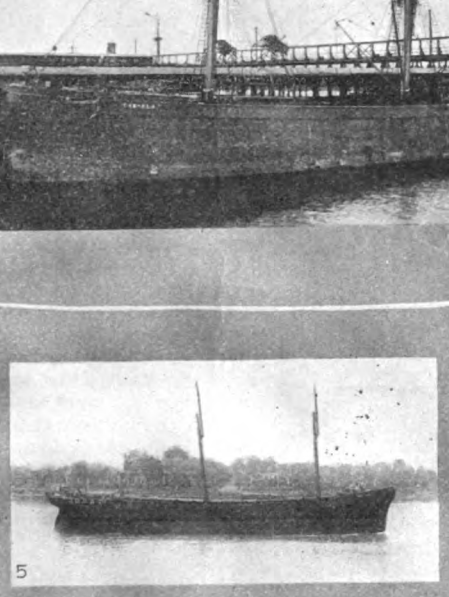

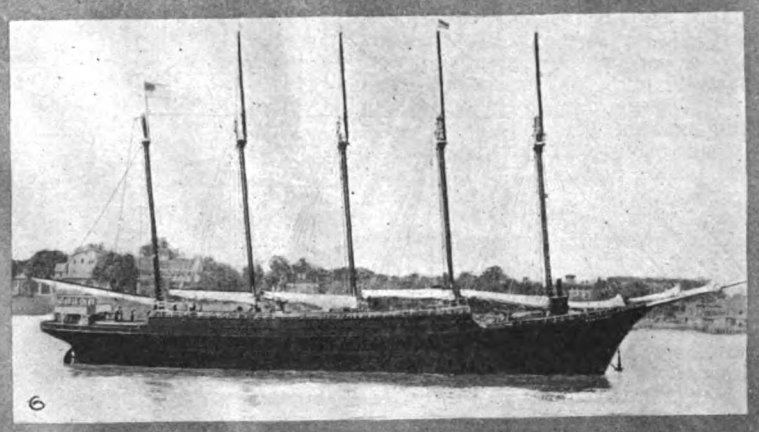

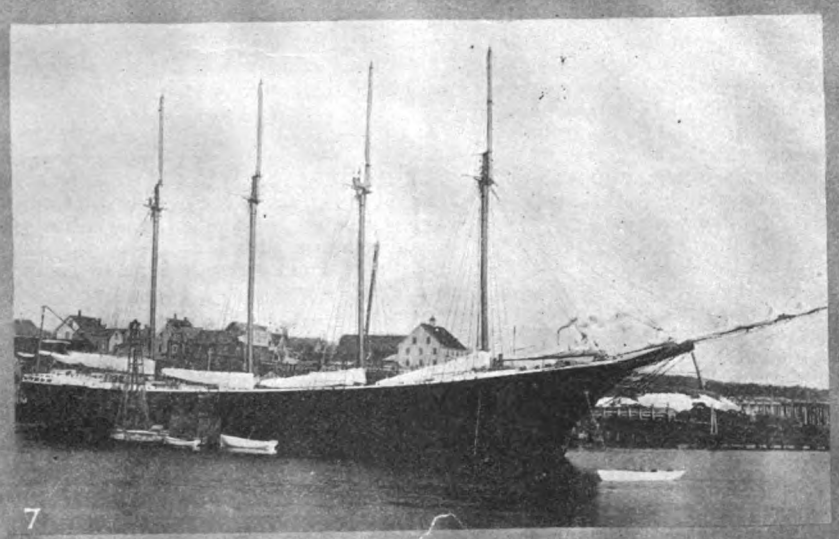

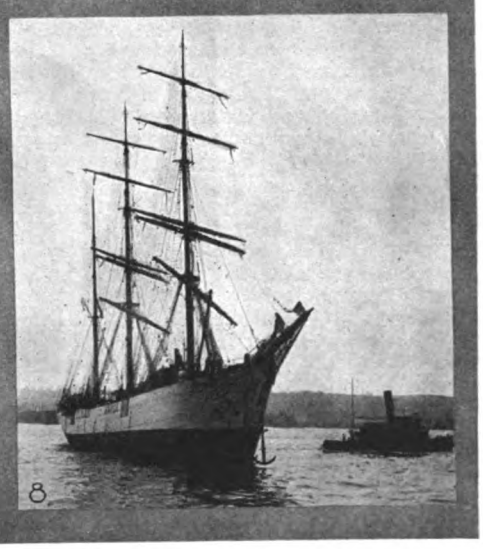

1. STEEL MOTOR-DRIVEN CARGO SHIP "YAVORI," OWNED BY THE SOUTHERN RAILWAY OF PERU.
2. AUXILIARY SCHOONER "ASTRI," A. O. ANDERSON & CO., NEW YORK.
3. AUXILIARY MOTOR BARK "CARMELA."
4. STEEL MOTORSHIP "ALEMBIC," W. S. JOB & CO., NEW YORK.
5. MOTOR BARGE "DANIEL B. MONROE," OWNED BY J. B. KING & CO., NEW YORK.
6. AUXILIARY SCHOONER "MARYLAND," TEXAS COMPANY, NEW YORK.
7. "PERCY R. PYNE," BUILT FOR MESSRS. W. S. JOB & CO.
8. MOTOR AUXILIARY "CUPICA EX ELFLEDA," MESSRS. CREW, LEWICK & CO., PHILADELPHIA.

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TEMPORI PARENDUM.

THERE are in this issue two "news items" from abroad, both of which are so startling in their significance that they are calculated to make all serious-minded American shipowners kick themselves real hard to ascertain if we are awake as a maritime nation, or, if it is that we are content with pillowing our heads on the sacks of money made in shipping since the war started and are slumbering in calm oblivion of all shipbuilding progress abroad, also in entire disregard of the future of American shipping. Yet we have set ourselves out to become the greatest maritime nation on earth!

One of these "news items" hails from Italy—the other from Denmark. Here is little Italy quietly, but gallantly, struggling almost unaided in a great fight for her very existence; but, her industrial-heads have sufficient presence of mind to realize that even they must be fully prepared to meet the great trade struggle among nations of this earth that will follow the cessation of this bloody war.

One of her greatest naval engineering and warship building companies, although almost overwhelmed with naval and military productions, has set aside a huge sum of money and has used it to open up two new great shipyards—one exclusively building large standardized steel Diesel-driven cargo motorships, the other building standardized wooden Diesel-driven cargo motorships. The tonnages are 8,000 tons d. w. c. and 2,500 tons d. w. c., and of 2,200 h. p. and 800 h. p., respectively, and both are being built in large numbers. Previously they have not constructed merchant motorships—only steamers and naval motor craft.

Here comes the almost unbelievable feature of this remarkable enterprise. They offer the wooden motorships for delivery in the first half of 1918, and the steel motorships for delivery in the second half of 1918—that is to say in 12 to 15 months' time. (This is written early in September). The Italian Government also realizes that the motorship is destined to be a great factor in the coming international trade war, and are subsidizing such vessels, also are allowing marine oil-engines to be imported from abroad free of the regular customs-duty. In this issue will also be found an advertisement of another great Italian engineering company boldly announcing their Diesel-type marine oil-engines to American shipowners.

What is of striking purport is that the first-mentioned shipbuilders, regardless of their large steamship building business bravely and wisely advise shipowners to change from steam to Diesel power. They say:

"Shipowners! It is now the time for maritime traffic to cease to be looked upon merely as a trade. It is now the time for shipowners to appreciate the discoveries of technical science and to cease from ignoring the teaching of progress."

Their courage is to be highly commended. No doubt their motorship business ultimately will pay them even better than steamship building.

An example of the same Italian company's foresight is to be found in another branch of their business, which is automobile and motor truck construction. We have it from a well-known British authority on automobiles that, during the war this branch has concentrated all its spare efforts and time on a new model motor-car, and have succeeded in developing a machine that surpasses anything yet built in any country. Later on it will be built in huge numbers for the world's markets. This has nothing to do with shipping, except that it indicates the general manner in which foreigners are getting prepared despite handicaps imposed by war. What little Italy can do, we also can do.

The news which emanates from Denmark comes direct from the shipbuilding yard of Burmeister & Wain, who for accuracy's sake desire to correct the impression that their yard has on hand orders for six years ahead. The real truth is, they say, that their great works are fully-booked with orders for large steel-built Diesel-driven motorships for eight (8) years ahead.

Surely this important announcement is sufficiently ominous for all discriminating shipowners, shipbuilders, the U. S. Shipping Board and the Emergency Fleet Corporation to take some rapid, active and definite action in the production of steel motorships.

It must clearly be evident that these Danish shipowners would not pay deposits, and enter into contracts, for ships eight years ahead unless they are absolutely certain that they will derive considerable benefit from such steps. They have sense to realize that, no matter the state and condition of the shipowning business in eight years from now there always will be a demand for a given number of ships and that motorships will be able to favorably compete against any coal or oil fired steamer in a period of business-slump. Hence the market value of motorships always will be much greater than that of steamers.

American shipowners must not let the present Government emergency commandeering of ships effect their actions in this direction, meanwhile nervously await in idleness and in fear of what the U. S. Shipping Board will do. Remember, while we are marking time, foreign shipowners are "up and doing." We are not a race of business cowards! Let us demonstrate it conclusively by our actions! The British Government has absolute control of its nation's merchant shipping and shipbuilding; yet, regardless of this, British shipowners are going ahead with the placing of orders for new ships just as if there was no Government control. American shipowners must do the same—their future existence demands it! Let us not merely live for the present, but let us look and think ahead—then act!

Finally, let us draw the attention of the great American steel shipbuilders to the fact that while this country still blissfully continues with the construction of steamers, foreign shipbuilders are going ahead with the development and perfection of the marine crude-oil burning internal-combustion-engine. We all admit that the Diesel engine has made far greater advances in Europe than in America. Therefore, we have to bear in mind that every year's delay places foreigners two more years ahead of us; because, while we shall have dropped another year behind the stage that they now have attained, they will have the advantage of an additional year's development. Hence our position in two or three years from now will almost be hopeless unless we accomplish something tangible without further delay. Shipowners and shipbuilders the title of this editorial forms an excellent "slogan,"—the writing is on the wall, we must yield to the times. Verbum sat sapienti.

THE SHORTAGE OF TANKSHIPS.

For several months Motorship has been agitating for the construction of large numbers of oil carrying tankers—particularly Diesel-driven vessels—and has drawn attention to the great shortage of this class of vessel. The U. S. Shipping Board now has realized the seriousness of the position. From our contemporary, the Oil and Gas News of Aug. 16th, we cull the following:

Oil Tanker Scarcity Serious.

"Scarcity of oil tankers is so great that a certain amount of oil which would ordinarily be exported in bulk is now being sent overseas in barrels and cases. Schooners are being used for this purpose. So far as can be ascertained few contracts have been let for tankers since the first of the year. This is due to the government needing all shipyard capacity, the situation being almost equivalent to a virtual commandeering of the yards. It is thought in some quarters that the government may permit the sidetracking of other construction in favor of oil tankers. It is reported that the seven tankers requisitioned last week were apportioned among six different companies, three being companies of the Standard Oil group, and three important independents. Rumors were circulated to the effect that the basis payment would be one-fourth to one-fifth of current charter rates, but it is now said that the basis of compensation will be fixed at a later date."

According to Sir Marcus Samuel, the Royal Dutch Shell Co. has 80,000,000 gallons of the first gasoline in storage, but there are not enough tankers to ship it.

THE DIESEL ENGINEER QUESTION.

Many months ago it was satisfactorily shown that the Diesel engineer difficulty was more a "paper" difficulty than a real one, and that the crux of the matter rested with the actions of shipowners themselves.

The question of the probable difficulty in securing competent engineers for Diesel-driven submarine-destroyers and for Diesel-driven freighters should they be adopted by the U. S. Government again has arisen.

According to the British Admiralty figures, on January 1st, 1914, there were built or building for various navies of the world 398 submarines, of which 271 actually were in service. Now, it is safe to assume that of these craft no fewer than 300 were Diesel engined, the remainder being steam and gasoline driven. This means that at least 2,500 Diesel engineers were required to operate the motors of these Diesel submarines, and a very excellent grade of engineer is demanded by Admiralties for this purpose.

Now, if there has been no great trouble in obtaining, or training, two-thousand-five-hundred engineers to operate the Diesel engines of the world's submarines, which number of men must have been increased to five thousand (5,000) since the war, no trouble should be met by the U. S. A. Government in training men to operate the Diesel engines of freighters and of submarine-destroyers. All that is necessary is to select intelligent marine steam-engineers and send them to the Diesel engine works for two or three months, when the engines are nearing completion and being tested.

RE NEPTUNE-DIESEL ENGINES OF M. S. "ARUM."

To the Editor of "Motorship":

Dear Sir—In my article on the Neptune-Diesel engines in the June issue of " Motorship" I said it would be valuable information to engineers to know whether any trouble arose from the use of telescopic-tubes for water-cooling the pistons. Messrs. Swan, Hunter & Wigham Richardson, Ltd., advise me they have pleasure in stating that they have found the system adopted with the engines of the M. S. "Abelia" and M. S. "Arum" entirely satisfactory, the latter mentioned vessel having been running for three years.

They also point out that in these engines the scavenging-cylinders (stepped-pistons) are used as air-engines when starting or maneuvering. One advantage of this, they say, is the use of starting-air at low pressure, namely, 50 to 100 lbs. per sq. inch. Secondly, the working cylinders are ready for firing as soon as the engine has started; thirdly, they think that by admitting starting air into the working cylinders, the undue cooling, due to this, increases the difficulty of the engine firing when starting (from cold). Needless to say I am glad to be able to place the remarks of Messrs. Swan, Hunter & Wigham Richardson, Ltd., before readers of my article on their engine.

At the same time I would like to add a tribute to the splendid manner in which this great British shipbuilding company has done its best to develop and encourage the Diesel-driven motorship, and some of our own big shipbuilders would not hurt to take a leaf from their book of progress. After the war Swan, Hunter & Wigham Richardson, Ltd., no doubt will reap the full reward that their efforts and patience deserve.

Yours very truly,
THOS. ORCHARD LISLE.

THE RELIABILITY OF STEAM POWER.

Some time ago we referred to heavy salvage damages being awarded in the case of the steam-driven oil-tank ship "San Orofre," due to the entire machinery being put out of business owing to a small break-down.

This steamer once more has been in trouble and now the owners, master and crew of the SS. "San Gregorio" have been awarded $150,000.00 by the British Admiralty court. Once again we suggest to the owners of the "San Orofre" that they install some good and reliable Diesel engines. She had aboard on this occasion a cargo of oil for the Admiralty which was worth $2,500,000.00.

HARLAND & WOLFF—BURMEISTER & WAIN.

The Burmeister & Wain (Diesel system) Oil Engine Company, Ltd., has been taken over by the Diesel engine department of Harland & Wolff, the great British shipbuilders. At Lancefield Quay, Glasgow, they have a most modern marine Diesel engineering works, where motors for many big ships are being constructed for Lord Pirrie interests.

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